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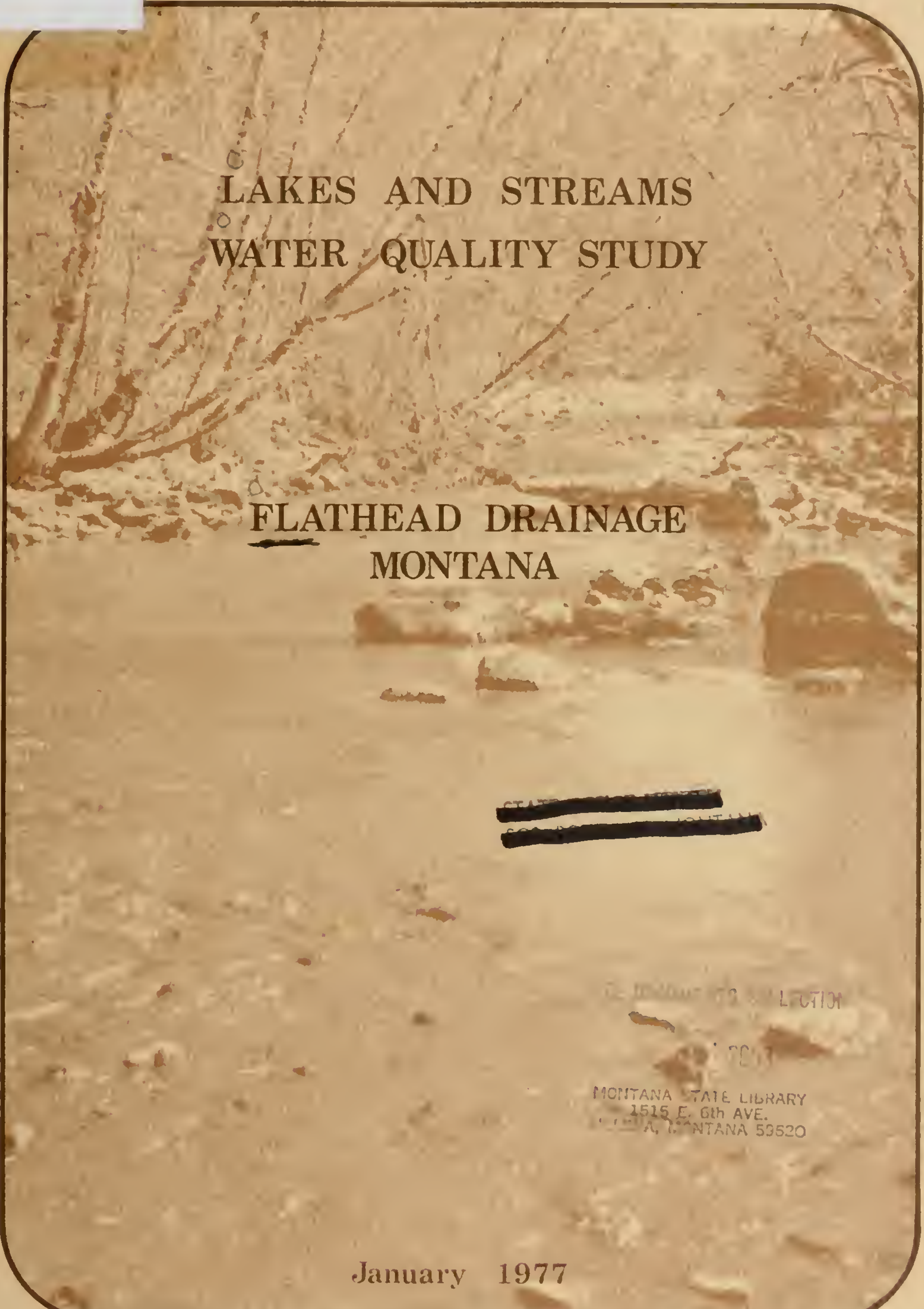

LAKES AND STREAMS WATER QUALITY STUDY

FLATHEAD DRAINAGE
MONTANA

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LAKES AND STREAMS WATER QUALITY STUDY

FLATHEAD DRAINAGE
MONTANA

Prepared For The
FLATHEAD DRAINAGE 208 PROJECT

by

Morrison - Maierle, Inc. and
James M. Montgomery, Consulting Engineers, Inc.

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Areawide Waste Treatment Management Planning Grant from the
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which because of their rural and undeveloped characteristic, are normally not regarded as being subject to intense degradation.

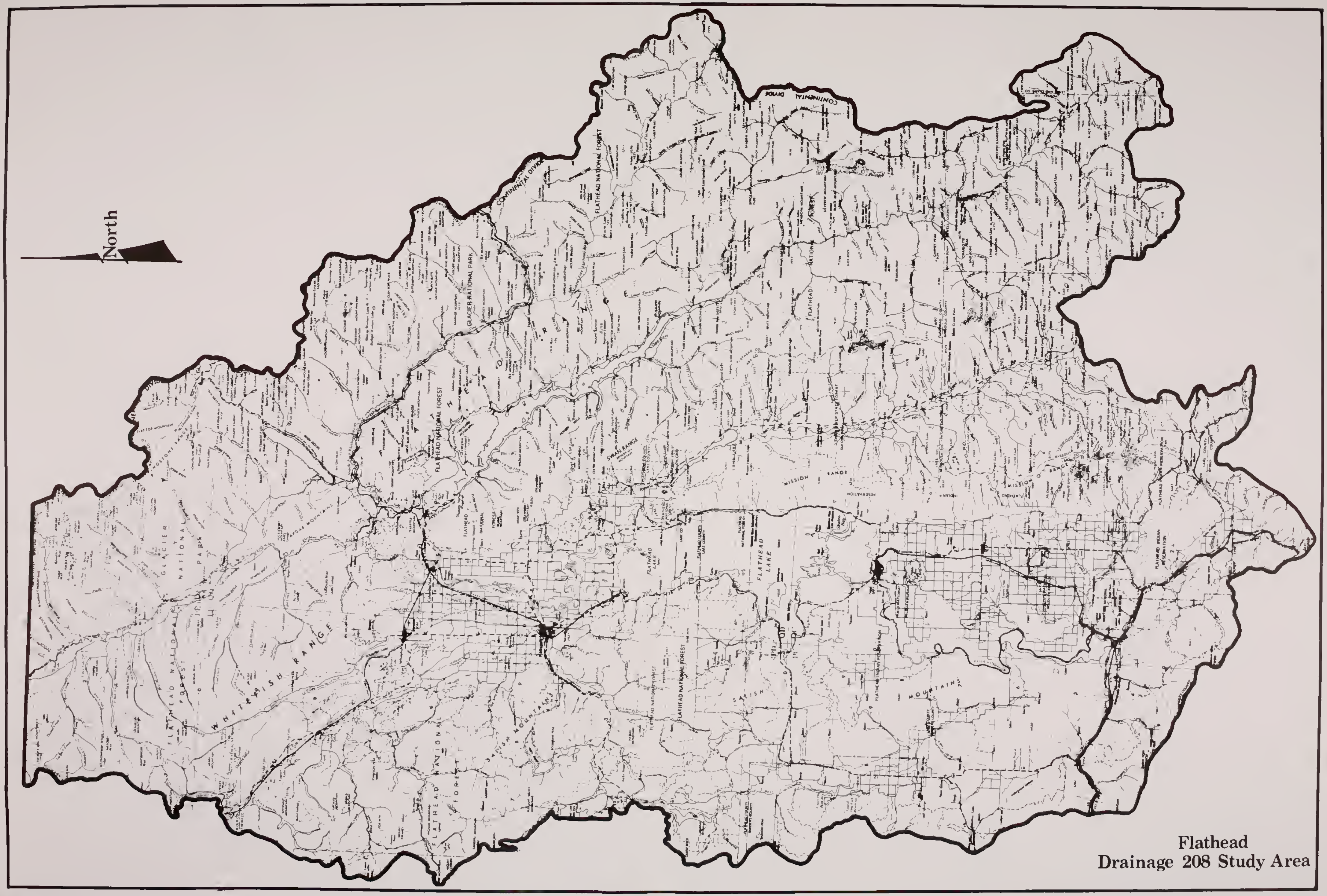
The goal of the 208 Study is to utilize the input of all the specialized technical studies (i.e., Water Quality, Land Capability, Point Source Analysis, etc.) and develop management policies for maintaining and improving the condition of the lakes, rivers, and streams in the drainage and their related resources. To this end the present report was organized as to provide planning and policy making entities with sufficient basic information to support the conclusion and recommendations formulated in the planning process.

DESCRIPTION OF STUDY AREA

The Flathead Drainage 208 Study Area was established, as prescribed in law, by the Governor of Montana to provide a mechanism to insure the coordinated and comprehensive waste management for the lakes and tributaries of the Flathead River. Figure 1-1 delineates the study area, its location and major natural and cultural features. For the purpose of presenting the information compiled, the study area was broken down into three major subareas and eight major drainages. The subareas were based upon the established geographic and economic units in the area. The designated drainages represent high priority lakes, streams, and drainage systems that were monitored for physical, chemical and biological parameters.

The preliminary review of the available data revealed that while a great deal of water quality information has been collected on various elements within the drainage, only the State Management Plans (303e) for the Flathead and Clark Fork address the overall water quality and discuss possible sources of point and nonpoint degradation. While the state plans addressed the problem based on existing information, the 208 Agency has elected to develop in depth field data on a number of critical or previously unstudied streams. In addition to the water quality monitoring and evaluation of the critical subdrainages, two lake restoration reports were prepared for submittal to EPA for funding consideration. The lake restoration evaluations on Foy Lake and Lake Mary Ronan, due to the limited time available to complete the study for submittal for 1976 EPA funding consideration, were limited to field reconnaissance, available existing water quality data, existing physiometric information and a new seismic geologic survey at Foy Lake.

Field studies were conducted on the eight streams and drainage systems given in Table 1-1 based upon priorities



Flathead
Drainage 208 Study Area

Figure 1-1

established by the FD 208 staff and advisory committees.

TABLE 1-1

WATER QUALITY STUDY PRIORITIES

Detailed Field Studies	No. Stations Sampled
1. Ashley Lake/River	8
2. Swan Lake/River	3
3. Whitefish Lake/River	3
4. Jocko-Finley Drainage	5
5. Mud-Crow Drainage	12
6. Stillwater River	4
7. Mission-Post Creek Drainage	11
8. Little Bitterroot River (at confluence)	1

The location of each sampling station is shown in Figures 1-2, 1-3, 1-4, and 1-5 and are described in detail in Table 1-2.

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TABLE 1-1

WATER QUALITY STUDY PRIORITIES

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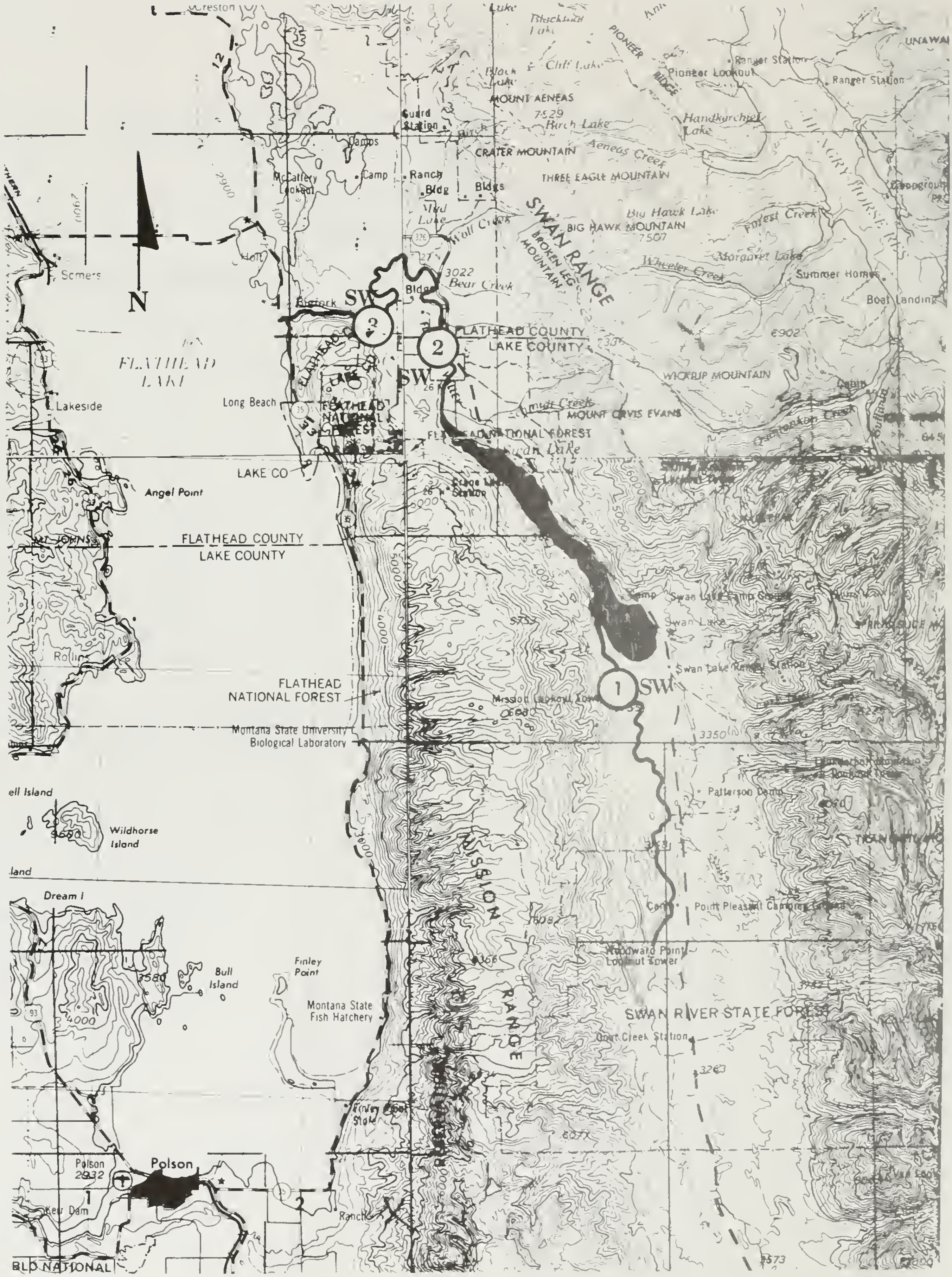
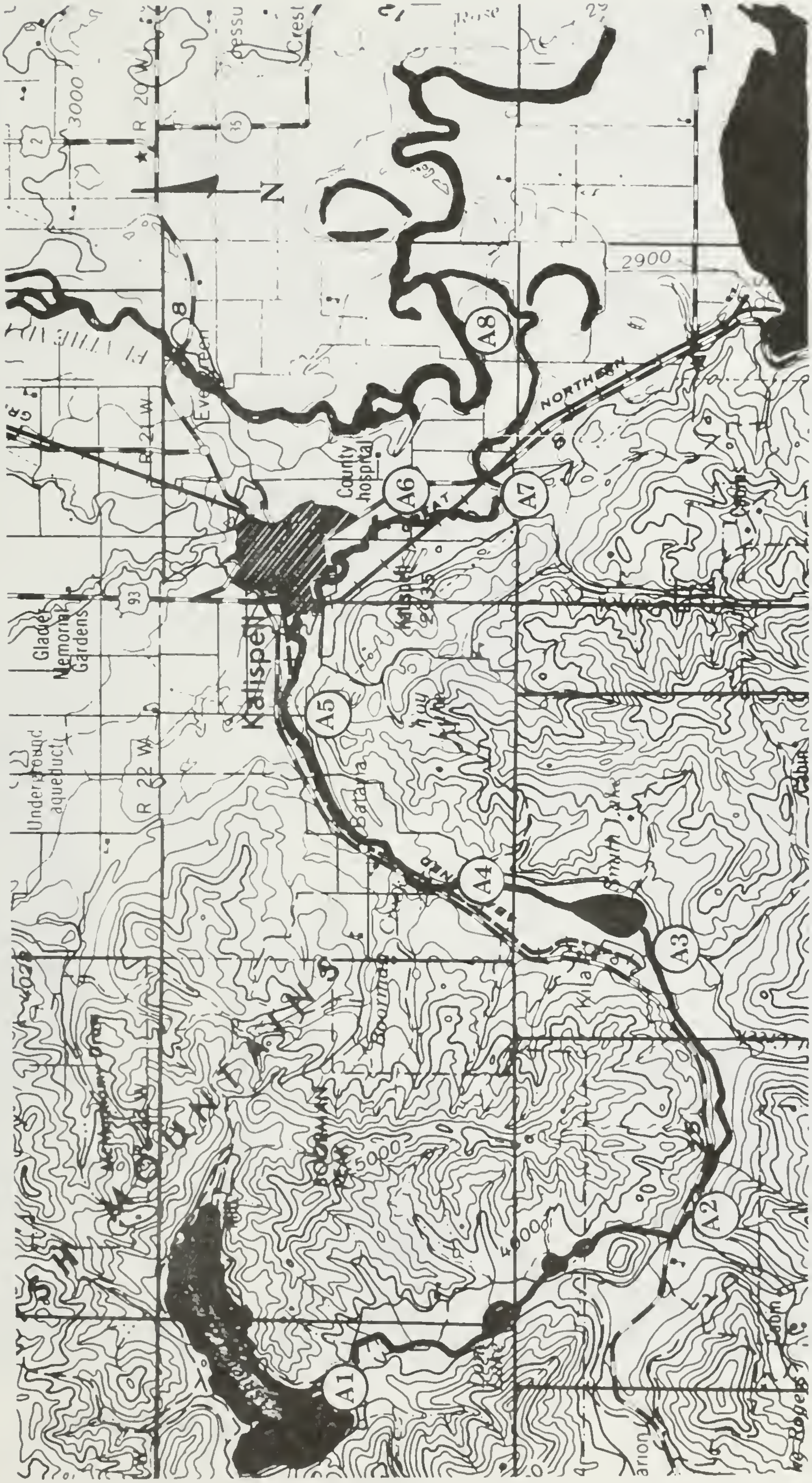
The location of each sampling station is shown in Figures 1-2, 1-3, 1-4, and 1-5 and are described in detail in Table 1-2.



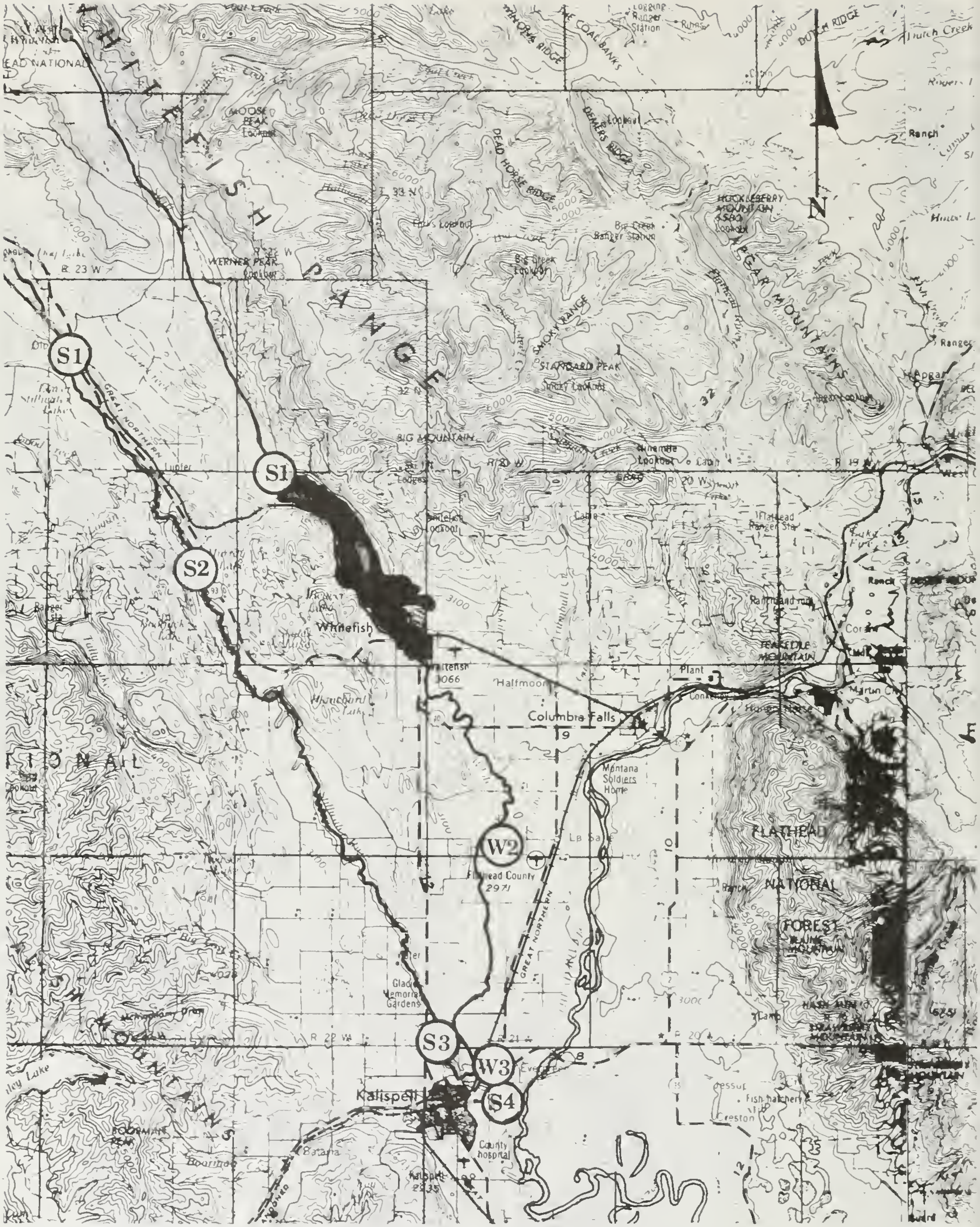
Swan River Drainage

Figure 1-4



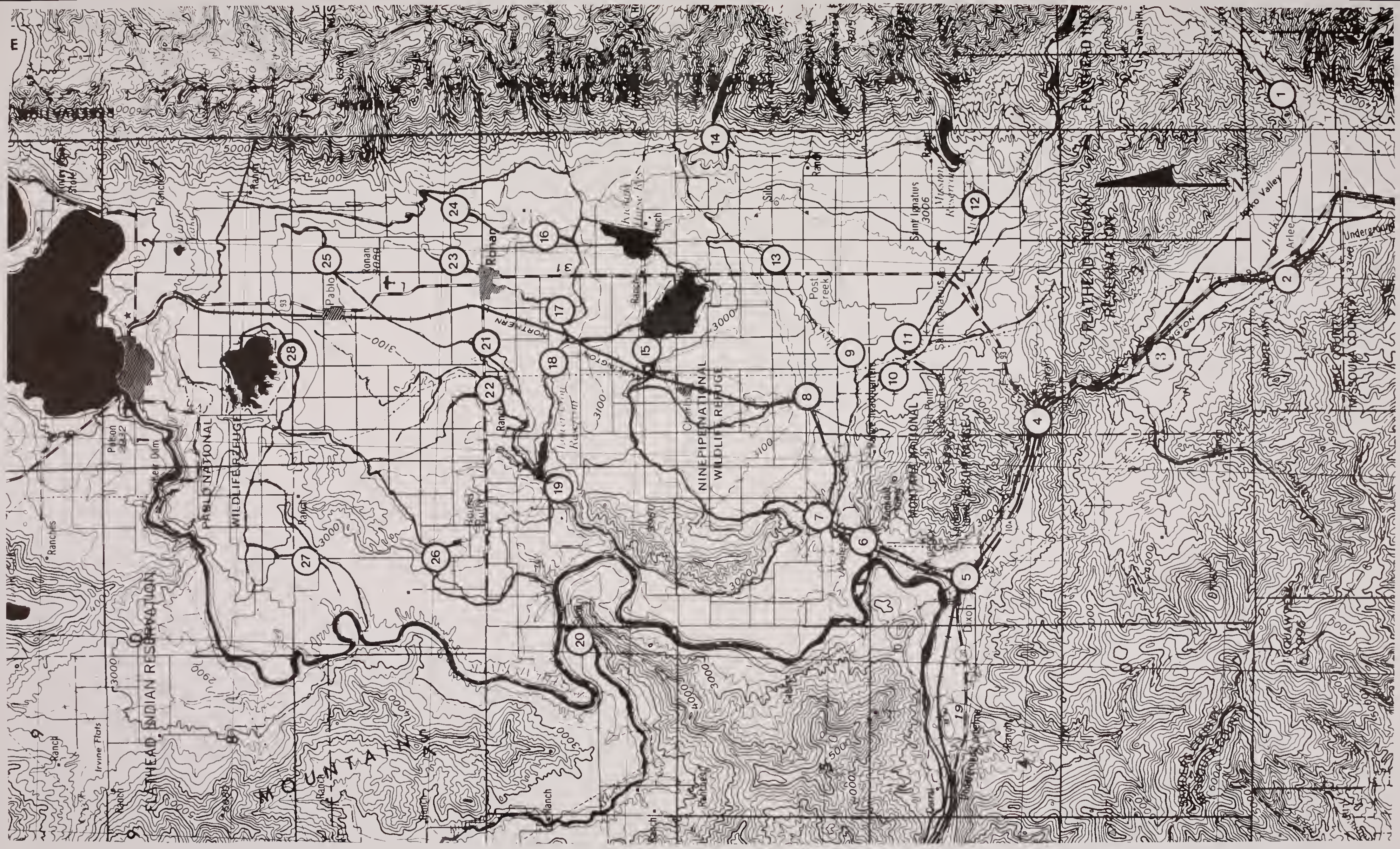
Ashley Creek Drainage

Figure 1-2



Whitefish, Stillwater Drainage

Figure 1-3



Lakes And Streams Water Quality
Agricultural Drainage Study Area

Figure 1-5

TABLE 1-2

DESCRIPTION OF MONITORING STATIONS

ASHLEY CREEK

No.	Name	Location	Pt. Sources	Non-Point
A-1	Ashley Lake Outlet	Ashley Lake Outlet		
A-2	Rogers Lake Turnoff	Rogers Lake Turnoff		Cattle
A-3	Inlet to Smith Lake	Inlet to Smith Lake		Cattle
A-4	Outlet from Smith Lake	Outlet from Smith Lake	Smith Lake	Cattle
A-5	Before town	Before town		Cattle, Homes, Feedlots (small)
A-6	Airport	Before STP		Town of Kalispell
A-7	After STP	West of Hiway 93	STP	Cattle
A-8	Mouth	East of Hiway 93 prior to entering Flathead		Cattle Homes
STILLWATER, WHITEFISH, AND SWAN RIVERS				
S-1	Upper Stillwater R.	Inlet to lower Stillwater Lake		Forestry
S-2	Mid Stillwater R.	Northwest of Whitefish		Agriculture
S-3	Lower Stillwater R.	West Reserve Drive		Agriculture
S-4	Lower Stillwater R.	After confluence with Whitefish		Town, Homes, Wood mill
W-1	Swift Cr.	Inlet to Whitefish Lake		Logging
W-2	Whitefish R.	West of Co. Airport	Whitefish STP	Agriculture

TABLE 1-2

DESCRIPTION OF MONITORING STATIONS

ASHLEY CREEK

No.	Name	Location	Pt. Sources	Non-Point
A-1	Ashley Lake Outlet	Ashley Lake Outlet		
A-2	Rogers Lake Turnoff	Rogers Lake Turnoff		Cattle
A-3	Inlet to Smith Lake	Inlet to Smith Lake		Cattle
A-4	Outlet from Smith Lake	Outlet from Smith Lake	Smith Lake	Cattle
A-5	Before town	Before town		Cattle, Homes, Feedlots (small)
A-6	Airport	Before STP		Town of Kalispell
A-7	After STP	West of Hiway 93	STP	Cattle
A-8	Mouth	East of Hiway 93 prior to entering Flathead		Cattle Homes
STILLWATER, WHITEFISH, AND SWAN RIVERS				
S-1	Upper Stillwater R.	Inlet to lower Stillwater Lake		Forestry
S-2	Mid Stillwater R.	Northwest of Whitefish		Agriculture
S-3	Lower Stillwater R.	West Reserve Drive		Agriculture
S-4	Lower Stillwater R.	After confluence with Whitefish		Town, Homes, Wood mill
W-1	Swift Cr.	Inlet to Whitefish Lake		Logging
W-2	Whitefish R.	West of Co. Airport	Whitefish STP	Agriculture

TABLE 1-2 (contd.)

No.	Name	Location	Pt. Sources	Non-Point
W-3	Whitefish R.	Just before confluence with Stillwater		Agriculture, Town of Kalispell
SW-1	Swan R.	Before Swan Lake		Logging, Agriculture
SW-2	Swan R.	After Swan Lake		Subdivisions
SW-3	Swan R.	Before Big Fork		Subdivisions, Agriculture
LOWER FLATHEAD VALLEY				
1	Upper Jocko R.			
2	Finley Cr.	At mouth of Finley		Cattle, Few Subdivisions
3	Mid Jocko R.	Between Arlee & Ravalli		Cattle
4	Lower Jocko R.	At fishing access site		Cattle, Fish Ponds
5	Jocko R. Mouth	Hiway bridge near Dixon	Jocko "J" empties in	Fish Ponds
6	Lower Mission Cr.	200 yds. beyond entrance of Hillside Res.		Buffalo, Cattle
7	Hillside Res.	At confluence of Mission		Irrigation Return Flows Cattle (feedlots)
8	Dublin Gulch	County Road crossing	Charlo sewage lagoons	Irrigation Return Flows Cattle
9	Lower Post Cr.	Prior to confluence with Mission	Fish Hatchery Ponds	Elk farm, Post-Pole, Cattle, Pigs
10	Sabine Cr.	Where it crosses the Bison Range	St. Ignatius sewage lagoons	Cattle
11	Mid-Mission Cr.	County Rd. crossing northwest of St. Ignatius	Possibly (?) sewage lagoons St. Ignatius	Cattle

TABLE 1-2 (contd.)

No.	Name	Location	Pt. Sources	Non-Point
12	Upper Mission Cr.	County Rd. crossing east of St. Ignatius		Cattle, Return Flows
13	Mid-Post Cr.	At junction with Mission "C" Canal	Mission "B & C" Canals empty in	Cattle
14	Upper Post Cr.	Outlet of McDonald Lake		
15	Ninepipe Reservoir	Outlet of Ninepipe Reservoir		Water fowl
16	Lower N. Crow Cr.	County Rd. crossing		Subdivisions, Cattle
17	Lower Spring Cr.	At County Road	Consolidated Dairies	Cattle
18	Mid-Crow Cr.	2nd County Rd.		Cattle, Irrigation Returns
19	Lower Crow Cr.	Outlet of Crow Reservoir	Mud Cr., W. Miller Coulee, Crow Creek	
20	Little Bitterroot R.	Mouth of Little Bitterroot		Cattle, Irrigation Return Flow
21	Lower Mud Cr.	W. of Ronan on Round Butte Rd.		Irrigation Return, Feedlots, Cattle, Fish Ponds
22	West Miller Coulee	W. of Ronan on Round Butte Road		Irrigation Return Flows, Feedlots
23	Upper Spring Cr.	Source of Spring Cr.		Feedlot
24	Upper North Crow Cr.	At recreation site		

TABLE 1-2 (contd.)

No.	Name	Location	Pt. Sources	Non-Point
25	Upper Mud Cr.	East of US 93 on County Rd.		Cattle
26	Lower Pablo "A" Canal	County Road crossing		Return Flows
27	Valley View Cr.	Valley View Ranch		Cattle
28	Pablo "A" Canal	Outlet of Pablo Reservoir		

SECTION 2

WATER QUALITY MONITORING AND STANDARDS

METHOD AND SCHEDULE FOR WATER QUALITY SAMPLING AND ANAYLSIS

Sample stations were located in order to best monitor any potential degradation from expected sources, and to facilitate rapid reproducible sampling. The information generated was weighted and does not reflect a random sampling of the entire stream network in any drainage, but a concerted effort on the part of the researchers to detect changes in background water quality. In all major drainages samples were taken at one point on the stream that would reflect baseline ambient background water quality conditions and could serve as a control for the remainder of the sampling points in that system. In the Upper Flathead and Swan drainages sampling was confined to the main river channels in order that the information collected could be compared to existing data. In the southern drainage (Jocko, Mission and Moiese Valleys) a variety of aquatic elements including rivers, creeks, reservoir outlets, irrigation ditches, and return drains were sampled. The extensive movement of irrigation water and the intermixing of instream and irrigation return waters have over the years created a situation where the distribution and collection network of the Flathead Irrigation Project has become in part, more or less integrated into the natural local hydrologic system of the region.

Water quality samples were collected on a regular schedule as presented in Table 2-1. Since little information was available for the agricultural areas of the southern drainage, a bimonthly collection and analysis schedule was adopted for these areas during the irrigation season. The remainder of the monitoring sites were sampled monthly. In addition, diurnal oxygen and ammonia analysis were performed several times on Ashley Creek and the Whitefish River because the State 303e Management Plan indicated that ammonia toxicity may be a problem for aquatic life as a result of discharges from the wastewater treatment plants at Kalispell and Whitefish.

The parameters that were sampled at regular intervals are listed on Table 2-1. Kjeldahl nitrogen was performed monthly in order to detect abrupt changes in nitrogen concentrations

TABLE 2-1

SAMPLING SCHEDULE

Station	Week	Parameters
Station 1 through 28		

Month	Week	Parameters
May	First	A,C
May	Third	A,B
June	First	A,C
June	Third	A,B
July	First	A,C
July	Third	A,B
August	First	A,C
August	Third	A,B
September	First	A,C
September	Third	A,B
October	First	A,C
November	First	A,C
December	First	A,C
January	First	A,C
February	First	A,C

Station	Week	Parameters
Station A1 - A6	Fourth each month (April - Feb.)	A,B
Station S 1-4	Third each month (May - Feb.)	A,B
Station SW 1-3	Third each month (May - Feb.)	A,B
Station W 1-3	Third each month (May - Feb.)	A,B

PARAMETERS

A.
1. Dissolved Oxygen
2. COD
3. Suspended Solids
4. Fecal Coliform
5. pH
6. Conductance
7. Alkalinity
8. Calcium
9. Sodium
10. Chloride
11. Potassium

B.
1. Nitrate
2. Total Phosphorus
3. Kjeldahl Nitrogen

C.
1. Nitrate
2. Total Phosphorus

that could indicate a substantial increase in either ammonia or organic nitrogen. Kjeldahl nitrogen does not include nitrate or nitrate nitrogen.

Field records were made on temperature, climatic conditions and flow at some stations. Additional flow records were supplied by the Flathead Irrigation Project for those streams and drains that they maintain record on in the Mission, Jocko, and Moiese drainages; and from U.S. Geological Survey Gauging Station on the larger rivers (i.e., Stillwater, Whitefish, Swan).

All chemical samples were analyzed by standard EPA approved methods as indicated in Standard Methods for the Examination of Water and Wastewater 14th Edition (Table 2-2) except for the determination of specific ions. These were measured using the Orion specific ions electrode method. Standard chemical determinations were conducted immediately after collection at a laboratory in Kalispell; or if necessary, stored over night under refrigeration and analyzed the following day. Nutrient samples (NO_3, PO_4 and Kjeldahl) were preserved following standard EPA recommended practices (4 mg/l $HgCl_2$) and shipped by bus to Billings for analysis. All tests were completed within 24 hours of sampling. Table 2-2 delineates the method of analysis utilized for chemical and biological parameters.

TABLE 2-2

METHOD OF ANALYSIS

Parameters	Method
Dissolved Oxygen	Winkler
Kjeldahl Nitrogen	Distillation
Nitrate	Cadimum reduction
Suspended Solids	Gravimetric (100° C)
Total Phosphorus	Ascorbic acid reduction
COD	H_2SO_4 digestion
pH	Electrometic
Conductance	Electrometic
Fecal Coliform	Membrane Filter Procedure
Alkalinity	Titrimetic
Calcium	Specific ion electrode
Sodium	Specific ion electrode
Chloride	Specific ion electrode
Potassium	Specific ion electrode

Collection of stream flow data was limited to stations that either had an official gauging station (USGS, FIP, etc.) or could be easily measured by field personnel during the collection of water samples. Flow information generated by the FD 208 in the Mission, Moiese and Jocko drainages should not be considered an absolute value. This information is, however, correct in terms of their relative magnitude on a month-by-month and a station-to-station basis. All calculated mass loading on these stations are based on these rough flow measurements and should be considered relative in terms of magnitude of concentration discussed. Table 2-3 identifies the source of flow data for each station where a measurement was possible. Field estimated measurements were generated by determining the cross sectional area of a segment of stream channel, and determining the velocity by timing the movement of a surface float and calculating the flow. No flow data was collected on Ashley Creek on a regular basis. Historic monthly flow records on Ashley are available from 1973-1974 and were used when appropriate to assist in the evaluation of conditions.

WATER QUALITY STANDARDS

The Montana State Department of Health and Environmental Sciences has established water quality standards for the drainages in the FD 208 Study Area based upon uses and some specific criteria. Table 2-4 presents a summary of the published classifications for the streams considered in detail in this study. Table 2-5 provides a summary explanation of the specific criteria and a comparative summary from different sources for various uses.

Montana Water Quality Standards also contain a number of general requirements which describe policies and criteria applicable to all water bodies in the state, except "where a specific water quality criteria is more applicable to a specific water use classification." The most encompassing of which is the non-degradation policy (Section 69-4808.2, R.C.M. 1947 Subparagraph 1, C iii, and 1, C iv) which states:

> "(iii) The board shall require that any state waters, whose existing quality is higher than the established water quality standards, be maintained at that high quality unless it has been affirmatively demonstrated to the board that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of these waters; and

TABLE 2-3

FLOW INFORMATION

Station	Source	Method
Whitefish*	USGS	Continuous Gauge
Stillwater*	USGS	Continuous Gauge
Swan*	USGS	Continuous Gauge
2	FD 208	Field Estimate
7	FHIP	Weir
6	USGS	Continuous Gauge
8	FD 208	Field Estimate
9	FD 208	Field Estimate
10	FD 208	Field Estimate
11	FD 208	Field Estimate
12	FIP	Weir
13	FD 208	Field Estimate
14	FIP	Weir
15	FIP	Weir
19	FIP	Weir
21	FD 208	Field Estimate
22	USGS	Gauge
23	USGS	Gauge
25	FD 208	Field Estimate
26	FIP	Weir
27	FD 208	Field Estimate
28	FIP	Weir

* One Station on Drainage
(USGS) United States Geological Survey
(FD 208) Flathead Drainage 208 Project
(FIP) Flathead Irrigation Project

TABLE 2-4

STREAM CLASSIFICATION

Stillwater River (Mainstem)	B-D_2
Whitefish Lake and it's tributaries	A-Open-D_1
Whitefish River (Mainstem)	B-D_2
Ashley Creek to and including Smith Lake	B-D_1
Ashley Creek, Smith Lake to bridge crossing and airport road, 1 mile south of Kalispell	B-D_2
Ashley Creek from bridge crossing on airport road to Flathead River	E-F
Swan River	B-D_1
Crow Creek	B-D_1
Crow Creek from road crossing (Section 16 T20N, R20W) to Flathead River	B-D_2
Tributaries to Crow Creek from road crossing (Section 16) to the Flathead River	B-D_1
Little Bitterroot at Flathead River	B-D_2
Mission Creek St. Ignatius water supply intact to U.S. Highway No. 93	B-D_1
Mission Creek from Highway No. 93 crossing to the Flathead River	B-D_2
Tributaries to Mission Creek from U.S. Highway No. 93 to crossing the Flathead River	B-D_1

TABLE 2-5

WATER QUALITY CRITERIA SUMMARY

PARAMETER	MONTANA SPECIFIC CRITERIA (1)				COMPARATIVE CRITERIA BY BENEFICIAL USE (2)			
(UNITS)	STREAM CLASSIFICATION				AQUATIC HABITAT (COLD WATER SPECIES)	CONTACT RECREATION	LIVESTOCK WATER SUPPLY	DOMESTIC WATER SUPPLY
	A-OPEN-D$_1$	B-D$_1$	B-D$_2$	B-D$_3$				
Coliform (3)	≤ 50/100 ml	≤ 200/100 ml	≤200/100 ml	≤ 200/100 ml	——	50-500/100 ml[b] 200/100 ml[a]	100/100 ml[a]	100-10,000/100 ml[a,d]
Dissolved Oxygen (mg)	> 7.0	> 7.0	> 7.0 Oct-Jun 1 > 6.0 Jun 2-Sep	> 5.0	> 7.0(spawning)[a] > 6.0(rearing)	——	——	> 4.0[a]
pH	6.5-8.5	6.5-8.5	6.5-9.0	6.5-9.0	6.0-9.0[a]	6.5-8.3[a]	≈ 6.0-8.5	6.0-8.5[a]
Temperature	32°F-66°F 1°F maximum increase 66°F-66.5°F no increase above 67°F > 67°F 0.5°F increase is allowable	Same as A-open-D$_1$	Same as A-open-D$_1$	32°F-77°F 3°F max. increase 77°F-79.5°F no increase above 80°F > 80°F 0.5°F increase is allowable	55°F(spawning) 68°F(rearing)[a,b] Change in temperature should not exceed 5°F above natural conditions for any month of the year	85°F[a]	≈ 85°F	85°F[d]
Turbidity	No change above natural occurring level	5 JTU increase over natural occurring level	10 JTU increase over natural occurring level	same as B-D$_2$	10 JTU[a]	4' secchi Disc[a]	——	——

TABLE 2-5 (contd.)

PARAMETER (UNITS	MONTANA SPECIFIC CRITERIA				COMPARATIVE CRITERIA BY BENEFICIAL USE			
	STREAM CLASSIFICATION				AQUATIC HABITAT	CONTACT RECREATION	LIVESTOCK WATER SUPPLY	DOMESTIC WATER SUPPLY
	A-OPEN-0$_1$	B-0$_1$	B-0$_2$	B-0$_3$				
Aluminum (mg/l)	(5)	(5)	(5)	(5)	1.0^{b}	—	5.0^{e}	—
Arsenic (mg/l)	0.01-0.05 (4)	0.01-0.05	0.01-0.05	0.01-0.05	<1.0^{b}	—	0.2-1.0^{b,e}	0.01-0.05^{d}
Barium (mg/l)	1.0 (4)	1.0	1.0	1.0	5.0^{b}	—	—	1.0^{d}
Boron (mg/l)	(5)	(5)	(5)	(5)	0.1-0.3^{c}	—	5.0	0.0-1.0^{a}
Cadium (mg/l)	0.01 (4)	0.01	0.01	0.01	1/30 TLM 96^{a}	—	1.0^{e}	0.00-0.05^{d}
Chromium-hexavalent (mg/l)	0.05 (4)	0.05	0.05	0.05	0.02^{a}	—	1.0^{e}	0.0-1.0^{d}
Copper (mg/l)	1.0 (4)	1.0	1.0	1.0	1/10 TLM 96^{a} 0.02^{b}	—	0.5^{e}	0.0-1.0^{d}
Cyanide (mg/l)	0.01-0.2 (4)	0.01-0.2	0.01-0.2	0.01-0.2	0.02^{b}	—	—	0.01-0.2^{d}
Iron (mg/l)	0.3 (4)	0.3	0.3	0.3	0.2^{b}	—	—	0.3^{d}

TABLE 2-5 (contd.)

PARAMETER (UNITS)	MONTANA SPECIFIC CRITERIA				COMPARATIVE CRITERIA BY BENEFICIAL USE			
	STREAM CLASSIFICATION				AQUATIC HABITAT	CONTACT RECREATION	LIVESTOCK WATER SUPPLY	DOMESTIC WATER SUPPLY
	A-OPEN-D_1	B-D_1	B-D_2	B-D_3				
Lead (mg/l)	$0.05_{(4)}$	0.05	0.05	0.05	0.1^b	—	0.05^e	0.05^d
Manganese (mg/l)	$0.05_{(4)}$	0.05	0.05	0.05	1.0^b	—	10.0^b	0.05^d
Nitrate (mg/l)	$45_{(4)}$	45	45	45	$.1-.3^{a,b}$ (biostimulation level)	—	100	45^d 10^a
Phenols (mg/l)	$0.001_{(4)}$	0.001	0.001	0.001	0.2^b	—	1000^b	0.001^d
Silver (mg/l)	$0.05_{(4)}$	0.05	0.05	0.05	$\approx 0.05^b$	—	—	0.05^d
Sulfate (mg/l)	$250_{(4)}$	250	250	250	$15-30^c$	—	500^b	250^d
Total Dissolved solids (mg/l)	$500_{(4)}$	500	500	500	2000^b	—	$2500-5000^{b,e}$	500^d 1000^b
Zinc (mg/l)	$5_{(4)}$	5	5	5	1/100 TLM 96^a	—	25^e	5^d

TABLE 2-5 (contd.)

FOOTNOTES

(1) See Montana Water Quality Standards for detailed specific water quality criteria conditions.

(2) Listed comparative criteria are suggested limiting concentrations with no adverse effect to the beneficial use.

(3) Average number of organisms in the Fecal coliform group.

(4) An increase of more than 10 percent above the concentration present in the receiving water is not allowed.

(5) Montana's non-degradation policy: Man's activities must not cause to increase the concentrations of toxic or deleterious substances above the existing water quality levels; unless it has been affirmatively demonstrated to the board that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of these waters.

REFERENCES

a. National Technical Advisory Committee, Water Quality Criteria. Federal Water Pollution Control Administration, 1968 Reprinted by the Environmental Protection Agency, 1972.

b. California State Water Resources Control Board, Water Quality Criteria, Second edition, Mckee & Wolf, 1973.

c. Washington State Research Center, Rambrow, Et al.

d. United States Public Health Service Drinking Water Standards, 1962.

e. University of California - Committee of Consultants to the California State Water Resources Control Board, April 1973.

> (iv) The board shall require any industrial, public, or private project or development, which would constitute a new source of pollution or an increased source of pollution to high quality waters, referred to in subsection (1) (c) (iii), to provide the degree of waste treatment necessary to maintain that existing high water quality."

Also in Section 69-4801 (2) in the statement of public policy it is stated:

> "(2) It is not necessary that wastes be treated to a purer condition than the natural condition of the receiving stream as long as the minimum requirements established under this chapter are met..."

The way in which these statements of law are interpreted will have a significant effect on the description and characterization of water quality problems and also on the evaluation of alternative control measures. It appears that there exists some latitude for change in the quality of water if it can be demonstrated the change is justifiable and will not impair designated water use.

It would also be desirable to define ".....that existing high water quality." If the phrase refers to a general condition of the water, it may be permissible to allow some increase in the discharge of constituents without measurably affecting the high quality. If the phrase refers to measured and documented concentrations of specific constituents, then point or non-point discharge known or expected to be of a lesser quality than that quality which has been measured and accepted as existing would be legally unacceptable.

The maximum concentration levels for specific constituents were established in some instances on limited water quality information; and in the case of a few drainages in the FD 208 Study Area, no data at all. In some instances, with new data and analysis, it may be desirable to revise specific elements of the state's water quality standards in order to maintain the existing high quality of a stream segment, or determine if it is impossible that a certain classification or specific criteria could ever be met. These considerations should be addressed in the planning and implementation of the FD 208 Study.

On the Flathead Indian Reservation, National Bison Range and National Parks in the area the state point source water quality standards are enforced by the EPA through the National Pollution Discharge Elimination System permit procedure. On all other lands in the study area this is controlled by the State of Montana permitting system.

SECTION 3

CHARACTERIZATION OF THE STUDY AREA

The FD 208 project area includes the Flathead River drainage lying in Flathead, Lake, Lincoln, Missoula, and Sanders Counties, Montana. The region is located in the great Rocky Mountain Trench, and covers the area from the alpine peaks of the Rocky Mountains along the Continental Divide to the arid glaciated valleys near the confluence of the Flathead and Clark Fork Rivers.

The Land Capability Report prepared under the direction of the FD 208 summarizes the geologic and geomorphic conditions responsible for the unique characteristics of the Flathead drainage. The upper and lower portion of the drainages are divided by the 28 mile long Flathead Lake which is the terminus of the upper drainage streams and the origin of the low reaches of the Flathead River.

In addition to the dominant features of Flathead Lake and River, numerous smaller lakes and streams make up the hydrologic regime of the region. These tributary drainages were the principal concern of this investigation. It is reasonable to conclude that the water quality conditions that exist in the tributaries of the Flathead River have a significant collective influence over the physical, chemical and biological characteristics of the area's overall water quality.

In general the Flathead River Valley was formed by down faulting in the late Paleocene era, followed by the action of ice and primeval lakes which alternately eroded and then inundated, depositing sand silts and clays (glacial flour) over the valley floor.

Much of the valley is underlain by glacial till and outwash that is overlain by a thin mantle of glacia-lacustrine silt and sand. Generally, the fill is a heterogeneous mixture of poorly sorted gravel, cobble and boulders, while the outwashes are a better sorted conglomerate with a more definite stratification.

The cutting, eroding and depositing action of the rivers in the region, as they etched themselves into the landscape, helped form and work the clays, sands and gravels into their existing physical features.

The climate of the study area generally varies from a moist maritime-type in the upper valley, to a drier continental to arid climate as you proceed further south and west. Precipitation in the main portion of the upper Flathead Valley averages about 15-20 inches a year with 40-60 percent of the annual rainfall occurring during the growing season. South of Flathead Lake the annual precipitation can be as little as 10 inches per year in the valley to as high as 48 inches in the mountains.

LAND USE IN THE FLATHEAD 208 STUDY AREA

Figures 3-1 and 3-2 summarize the major land use types inventoried by the Flathead and Lake County planning agencies. The portion of each county shown in these figures includes those areas within drainages investigated during this study. These figures are somewhat generalized and a number of smaller units or land types were omitted to facilitate a concise graphic presentation.

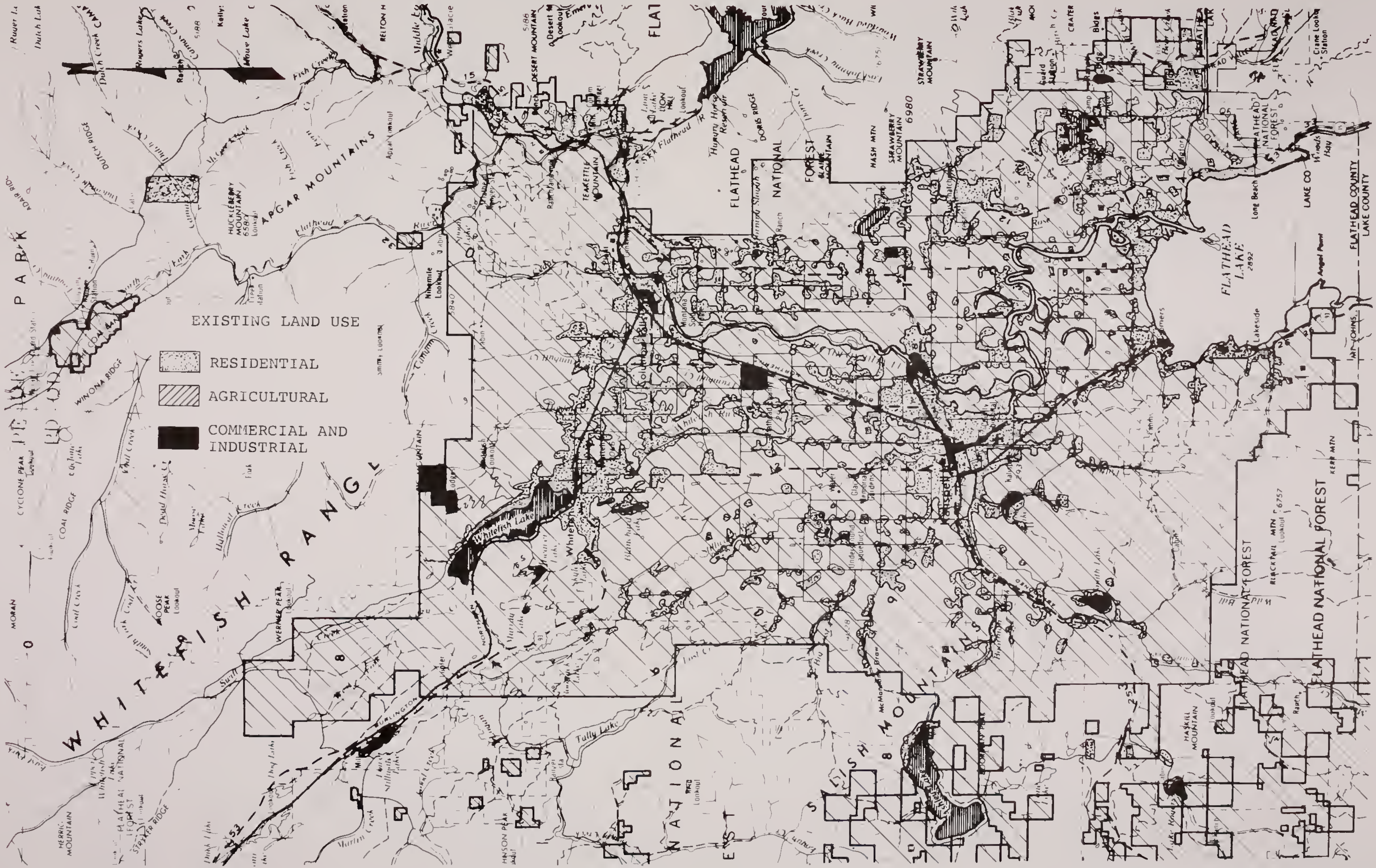
Land utilization within the study area is restricted primarily to agriculture, silviculture, and scattered residential/urban development. The distribution and impact on water quality of these three classifications are discussed under the individual drainages.

ASHLEY CREEK DRAINAGE

The geologic processes which formed the Smith Valley west of Kalispell played a large role in determining the water quality of Ashley Creek. As the glaciated mass moved through the Flathead Valley, an arm moved into the Smith Valley and began to push its way uphill. The front of this glacier formed an ice dam to water flowing down the valley thus shaping the progenitor of Smith Lake. As the lake aged, it has slowly filled in, creating a marshy area to the west.

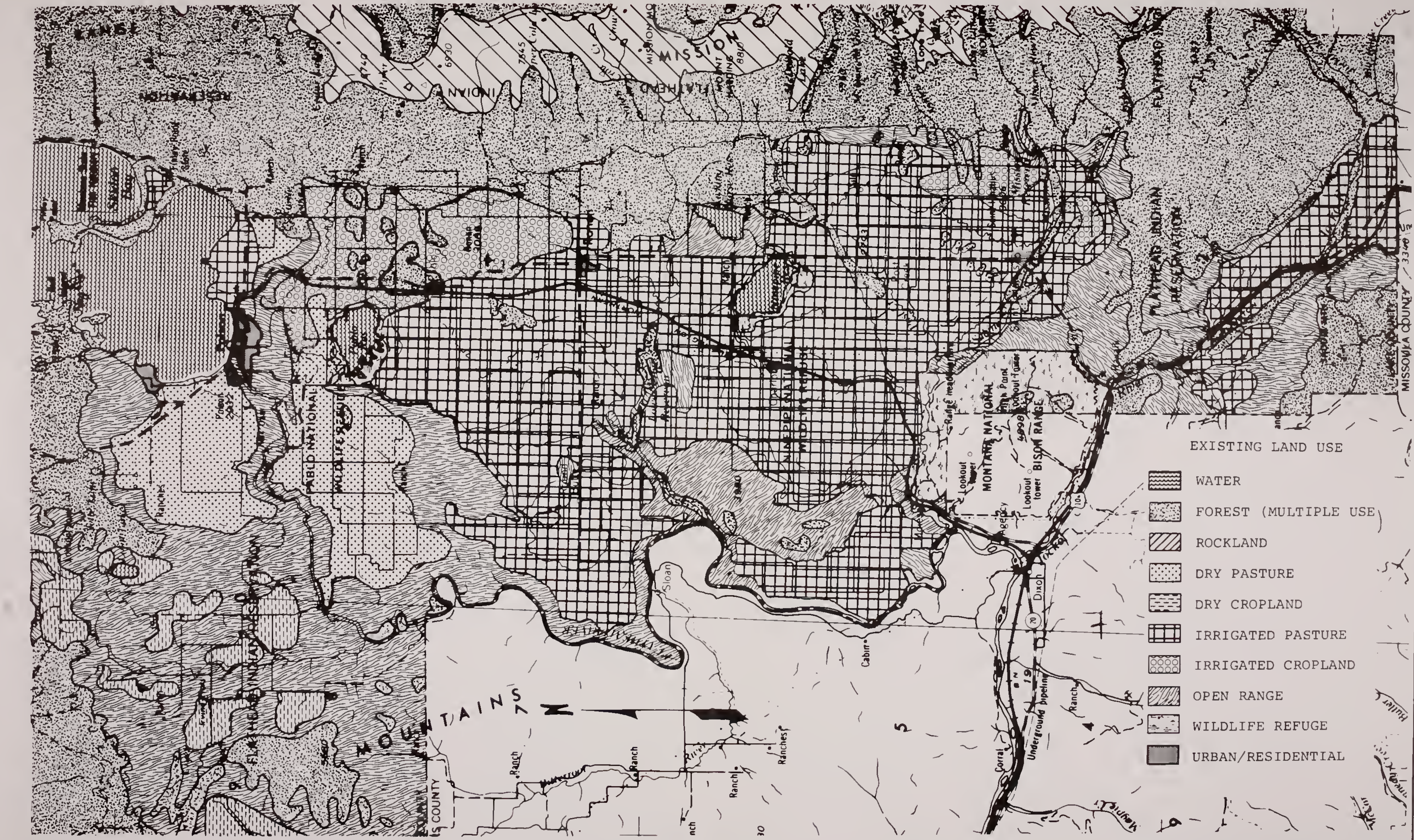
The glacial deposits and till through which Ashley Creek passes are moderate to high in erodibility when the ground cover is removed. Eroded slopes usually result in slumping or cut slope failure, and highest instability would be expected during periods of high runoff or high groundwater.

As Ashley Creek flows out of Ashley Lake through the surrounding agricultural lands, it picks up organic matter from Smith Lake as well as from nonpoint source agricultural drainage and runoff. As it leaves Smith Lake and begins flowing northeast towards Kalispell, it has a very distinctive organic color. Before reaching Kalispell, Ashley Creek



Lakes And Streams Water Quality
Flathead County Study Area
Land Use

Figure 3-1



Lakes And Streams Water Quality
Agricultural Drainage Study Area
Land Use

Figure 3-2

is subjected to potential degradation from the subdivisions and other urban development along its banks. It also flows by an adjoining feedlot approximately two miles west of Kalispell and a lumber mill. Passing through town Ashley Creek receives urban runoff which is often high in salts and other exotic (greases, oils, pesticides, etc.) and domesitc pollutants.

Perhaps the most significant single impact on the water quality of Ashley Creek is the Kalispell Sewage Treatment Plant. This facility discharges up to 1.3 mgd of secondary chlorinated effluent. From the City of Kalispell until its confluence with the Flathead River, Ashley Creek is very slow moving, muddy and often has large mats of duck weed floating on its surface. After crossing the highway south of Kalispell, Ashley Creek meanders through an area of agricultural crop lands (hay and small grains) until its eventual confluence with the Flathead River.

A number of specific water quality problems have been noted within the State of Montana's 303e plan concerning Ashley Creek. The major factor influencing the condition of the drainage, according to the state report, is again the discharge of the Kalispell Sewage Treatment Plant and its alleged associated nutrient, temperature and ammonia toxicity problems. The 1976 Management Plan summarizes the general condition in Ashley Creek as follows:

> "Ashley Creek above the Kalispell sewage plant is far from pristine. Heavy development and livestock use of the stream banks, and overappropriation of water rights for irrigation, contribute to making this low gradient stream also a low quality stream. Upstream, the warming effects of Smith Lake reduce the quality of Ashley Creek as a fishery, although the stream does support a trout population above Kalispell. Trout and salmon runs are presently blocked from entering Ashley Creek, at least seasonally, by impaired water quality. While the situation will improve somewhat as the operation of the Kalispell sewage plant reaches design efficiency, the nutrients will probably remain sufficient to cause algal blooms in the lower stream and attendant oxygen blocks. The only long range fishing solution for Ashley Creek would be to remove the Kalispell sewage discharge from the stream completely."

STILLWATER RIVER DRAINAGE

The Stillwater River flows out of Lincoln County through the Stillwater State Forest to Lower Stillwater Lake. To that point it flows mainly through forested land and is subjected primarily to the influences of silvicultural activities, and several small towns and scattered ranches along its banks. The Montana Department of Natural Resources and Conservation surveyed the extent of logging and associated activities in the Stillwater River and found that 5.0 percent of the forested acres had been harvested and 29.0 percent had been burned at one time. They inventoried approximately 45 miles of low-standard roads in the area. As the Stillwater River leaves Lower Stillwater Lake it flows past lands recently subdivided and eventually reaches the major agricultural region of the Upper Flathead Valley. As the Stillwater River courses through the agricultural lands of the upper valley, water is pumped away from the river to provide irrigation water for sprinkler systems. There are no towns or point discharges to the river until it reaches Kalispell. As the river flows through Kalispell, it passes next to a lumber processing mill, merges with the Whitefish River and flows into the Flathead River. Following its confluence with the Whitefish to its final destination at the Flathead River the merged river passes through a rather backwatered area characterized by sloughs, dense riparian vegetation and scattered residential developments. The Stillwater and the Whitefish Rivers are both very slow flowing, low gradient rivers which sometime appear to not be moving at all.

Erosion hazard is generally high from both water and wind in the agricultural areas of Flathead Valley. The glaciolacustrine deposits in this area are susceptible to erosion when exposed on even mild slopes. Stream bank erosion is particuraly high along the Lower Stillwater and Whitefish Rivers. While much of the stream bank cutting and sloughing is a natural process, irrigation in the region including sprinkler applied, helps to increase the likelihood of stream-side instability. The milky appearance of the lower Stillwater River is in part attributable to the suspension of fine stream-side colloidal-like material. During the field investigation of the agricultural practices in the Stillwater drainage a moist band was observed along the banks of the river. This band was apparently the zone of horizontal groundwater movement, which under certain conditions may lead to liquefaction and slope failure. While this eroding of the stream bank occurs constantly on a localized microlevel, it has on occasion, caused massive failure which has closed or practically closed the channel for short periods of time.

The 1972 Conservation Needs Inventory prepared by the Soil Conservation Service indicated the type of crop and irrigation practices in Flathead County.

	Irr. Acres	Non-Irr. Acres	Total
Row Crops (potatoes, berries, etc.)	950	710	1,660
Close-grown Field Crops (wheat, barley, etc.)	4,558	43,386	47,944
Summer Fallow	0	22,637	22,637
Rotation Hay & Pasture	5,734	13,966	19,700
Hay Land	3,425	17,187	20,612
Total Acres	14,667	97,286	112,553

The majority of the 16,000 acres of irrigated agricultural lands within 265,600 total acres in the lower Stillwater drainage are under sprinkler irrigation. Only one major feedlot or livestock confinement area was inventoried within the Stillwater drainage by the FD 208 Agency during analysis of water quality conditions. No serious water quality problems, as a direct result of man-related activities, were identified by the State 303e plan in the Stillwater River.

The limited return of the fall Kokanee run (State 303e Flathead River Basin) indicates that there may be some overall improvement in the general water quality of the Stillwater occurring.

WHITEFISH RIVER DRAINAGE

The Whitefish River flows out of Whitefish Lake, which is fed primarily by Swift Creek. The drainage of the Whitefish River in the study area is 82,795 acres, of which 7 percent is irrigated farmland. Irrigation is almost totally sprinkler with little irrigation return flows. As the river leaves Whitefish Lake it goes through the town of Whitefish and receives the effluent from the City of Whitefish Sewage Treatment Plant, and from the Burlington Northern oil skimmer ponds, both of which are permitted under the State of Montana's Discharge Elimination Permit System. From here the river traverses the upper Flathead Valley, which is largely agricultural land on old lake bed sediments. In many years the flow in the Whitefish in late summer is extremely low. The Soil Conservation District has proposed the construction of a regulating structure at the outlet of Whitefish Lake which would guarantee more irrigation water, plus assure a minimum flow of 50 cfs in the Whitefish River in most years.

The area around the town of Whitefish and the ski area at Big Mountain are undergoing subdivision and condominium development at an increasing rate. The impact on water quality of the accompanying urban runoff, wastewater disposal and surface drainage and runoff from ski runs may be a problem that's just beginning to be realized in the upper portions of the Whitefish drainage.

Above Whitefish Lake the land is heavily forested and sparsely developed. Swift and Lazy Creeks are the major tributary drainages to Whitefish Lake. The EPA's recently completed eutrophication study on Whitefish Lake indicated that non-point sources contributed nearly all the total nutrients to the lake with the majority entering from Swift Creek. The survey concluded the Whitefish Lake "ranks first in overall trophic quality" when compared with the 15 Montana lakes and reservoirs sampled in 1975. Approximately 24.0 percent of the 11,900 forested acres in the Swift Creek drainage has been harvested and 7.0 percent burned. Over 150 miles of forest roads have been constructed in the area.

The lake bed sediments, which form the banks of the Whitefish and the Stillwater, are very unstable when wet. It is common to have the banks of either or both undergo major sloughing several times per year. This happens, as described previously, when water percolates through the soil until it hits an impermeable barrier, then moves laterally. If and when the water reaches a river bank, it can cause the bank to saturate and slough into the river causing a turbidity and solids problems. This is a natural phenomenon, but it can be aggravated by various land use influences such as over-irrigating or irrigating too close to the river bank. Two feed lots were inventoried in the general Whitefish drainage; one on Trumbull Creek southwest of Columbia Falls and one near Haskill Creek east of the Town of Whitefish. Just prior to its confluence with the Stillwater River, the Whitefish courses through some of the outlying areas of Kalispell where it is probably affected by septic tanks and/or urban runoff. Spring Creek also enters the Stillwater River and has been heavily impacted in recent years by subdivision activity (i.e., runoff, individual wastewater disposal systems). In past years a large feedlot also contributed to impaired water quality in Spring Creek, but it is no longer in operation.

The State's Water Quality Inventory and Management Plan has indicated that the major impact on instream water quality is from effluent discharges from the Whitefish Wastewater Treatment Plant. Agriculture and silviculture in the headwaters were also considered potential sources of suspended solids and nutrients, but to a lesser degree.

SWAN RIVER DRAINAGE

The Swan River flows northwest from Lindberg Lake through the Swan Valley to Swan Lake. As it moves through the heavily wooded valley, it collects tributaries from the east slope of the Mission Mountains and the west slope of the Swan Mountains. The bulk of the land ownership is controlled by the State of Montana and Burlington Northern, whose interests lie in its timber value. The private land in the river bottom is primarily recreational, although there are some lands utilized for grazing. The soils are glacial in origin and normally do not show any evidence of accelerated erosion when exposed. Runoff is essentially clean, and gullying or sheet erosion problems are not in evidence.

Swan Lake is a very long and narrow body of water which flushes approximately four times a year. The lake is very clear and has only one small community at the southeast edge. Due to the configuration of the lake and the southern entrance of the river, it appears the section of the lake on which the town of Swan Lake is located is subject to less flushing than the rest of the lake. While this does not appear to jeopardize overall water quality at this time, it may in the future, if additional growth within the town of Swan Lake is allowed to proceed without consideration for water quality protection.

Upon leaving Swan Lake, the river flows north then loops west toward Flathead Lake. Along this stretch of river there are a number of individual homes and residential subdivisions which are replacing former agricultural uses.

One mile above Bigfork the Swan River is dammed by a low diversion structure which diverts some of the water to a power generating facility.

In general, the Swan River is of exceptionally high quality and serves as the domestic water supply for the Town of Bigfork, requiring only chlorination. The present major impact on the system is the low diversion dam which has seriously reduced the migrant fishery in the river.

LOWER FLATHEAD VALLEY (Mission and Jocko Valleys)

Within the Mission and Jocko Valleys, Crow, Post, Mud and Mission Creeks along with the Jocko and Little Bitterroot Rivers were studied. The underlying geology in these areas is similar, being composed of glacial till and lake bottom sediments laid down by prehistoric Lake Missoula. Alpine and the main valley glacier deposited till makes up the material found at the base of the Mission Mountains. The soils are highly porous and as a result, much of the runoff from the mountains descends to the groundwater and resurfaces in the numerous springs found throughout the Mission Valley. Rainfall in the Lower Flathead Valley (Lake County) varies greatly ranging from as low as 10 in/yr at the Flathead River to over 40 in/yr at the base of the Mission Mountains.

Agriculture in these valleys differs considerably from that in the Flathead, being based almost entirely on small cattle holdings, irrigated pasture and hay, and some limited field crops (potatoes) in the northwest portion. In 1974, the State Department of Revenue reported 20,200 head of cattle in Flathead County as opposed to 53,071 in Lake County. This emphasis is also seen in the crops grown (see below).

	Irr. Pasture	Hay	Grain	Potatoes
Jocko	10,309	5,685	559	-
Mission	88,258	36,483	12,092	2,422
Total Acres	98,567	42,168	12,651	2,422

From a water quality standpoint the largest difference in agricultural practices between Flathead and Lake Counties is in application of irrigation water. In Flathead County virtually all of the irrigation is applied by sprinkler. According to the SCS 1975 field inventory of irrigated land, only 25 percent of the irrigated acres are sprinkler and the remaining 75 percent are flood irrigated. In their 1976 study the FD 208 Agency inventoried 13 livestock feedlots or confinement areas within the Lower Flathead Valley drainage area considered in this investigation.

The State of Montana's Water Quality Inventory and Management Plan prepared in 1975 has very little specific information on the water quality of the tributary streams of the Lower Flathead Valley. In general terms, they indicate that the combination of irrigation withdrawals and dewatering, combined with the irrigation return flows and agricultural runoff, can degrade instream water quality. No specific examples or documented instances of degradation were identified, but since only limited water quality data is available from the area, conclusive statements on water quality were difficult to make.

JOCKO RIVER DRAINAGE

Flowing out of the Mission Mountains the Jocko River traverses a narrow valley which is composed largely of glacial deposits. Most years, upstream segments of the Jocko River are totally dewatered for irrigation purposes. However, because the glacial material is so porous and the water table is high, the river is recharged by the time it reaches to Arlee. The Jocko River drains an area 167,400 acres in size. Of this area, 12 percent is presently under irrigation. This percentage is much less than in the Crow and Mission-Post drainages (46% and 50%). Three feedlots (livestock confinment areas) were identified in the Jocko Valley in the area between the Towns of Arlee and Ravalli. Silviculture activities and logging in the Mission Mountains along with some residential and limited municipal development also influenced water quality in the drainage.

As the Jocko River leaves Arlee and heads northwest, the river is influenced to some extent by discharges from several commercial trout ponds along the river and by Finley Creek. Finley Creek originates in Missoula County, flows north, and drains an area which is largely agricultural (pasture, cattle). There has been some residential subdivision activity in the drainage. Water entering the Jocko River from Finley Creek during spring runoff is notably different in visual appearance. Sediment loading from surface runoff imparts a turbid discoloration to Finley Creek which appears as a differentiated laminar band for some miles down the Jocko River following its confluence. After the confluence with Finley Creek, the Jocko flows through lands used primarily for hay and pasture. At the town of Ravalli the river turns west. From this point, the river is channelized and heavily rip-rapped, traversing through agricultural lands to its confluence with the Flathead River near Dixon.

The Lower Clark Fork River Basin Water Quality Inventory and Management Plan does not identify specific known water quality problems in this stretch of the Jocko. It does, however, indicate that the Jocko is "moderately to severely affected by irrigation withdrawals." Limited water quality data was collected by the Water Quality Bureau in 1974; three times near Arlee and once at Dixon. No other water quality information apparently exists for the Jocko in the FD 208 Study Area.

MISSION AND POST CREEKS

Mission and Post Creeks flow from the Mission Mountains draining a valley area totaling 124,179 acres of which approximately 46 percent are irrigated. As Mission Creek flows out of the Mission Mountains across the agricultural lands of the valley and approaches St. Ignatius, two large irrigation canals intercept its flow. These canals divert water to the north, delivering irrigation water and collecting return flows. These return flows are eventually delivered to Post Creek. Mission Creek, greatly reduced in volume, flows near the Town of St. Ignatius where it receives the discharge, via Matt Creek, from one of three sewage lagoons serving St. Ignatius. Southeast of the Town of St. Igantius, Mission Creek is bounded on both banks by a small feedlot (2 acres) that allow cattle access to over 100 feet of stream. From this point it travels through marshy and primarily agricultural lands until its confluence with Post Creek.

Post Creek flows from McDonald Reservoir into the Mission Valley and, as noted above, picks up return flows from Mission "B" and "C" irrigation canals. These discharges may seriously degrade the quality of Post Creek. As Mission Creek continues west it receives waters from smaller irrigation drains. After crossing Highway 93, Post Creek passes near post-pole yard, the Flathead-Kootenai Elk Farm (soon to be phased out), a commercial trout farm and a number of farms and ranches before it's joined by Mission Creek.

At the confluence of Mission and Post Creeks the water from Post appears (visually) to be of lower quality and higher in suspended matter. Shortly after the confluence, Sabine Creek flows into Mission after running through agricultural and pasture lands receiving the discharge from the two other lagoons at St. Ignatius. Dublin Coulee also enters Mission Creek in this area. Dublin Coulee is composed almost entirely of agricultural return and natural runoff. There are a considerable number of cattle in its drainage (small feedlot 0.5-1 acres) and the water has a distinct organic color. Dublin Coulee intermittently receives discharges from the Charlo Sewage lagoons during the high spring runoff, but is almost entirely agricultural return flow throughout the irrigation season.

Hillside Reservoir overflow enters Mission Creek just as it leaves the National Bison Range. It is composed entirely of irrigation return flow and agriucltural runoff. As it leaves Hillside Reservoir the overflow goes through a tight canyon composed of erosive lake bed sediments. There are a considerable number of cattle in this canyon who feed along its banks. After its confluence with Hillside Reservoir outlet canal, Mission Creek flows to the Flathead River picking up return and overflows from irrigation in the Moiese Valley.

As with most of the streams in the lower Flathead Valley, there is very little available water quality information. The State of Montana's Lower Clark Fork River Basin Water Quality Inventory and Management Plan (303e) lists irrigation withdrawal as the only documented water quality problem and identifies the available monitoring data as that collected by the Water Quality Bureau in 1974.

CROW CREEK DRAINAGE

Those portions of the Crow Creek drainage evaluated during this study were comprised of North Crow Creek, Mud Creek, and West Miller Coulee, all of which eventually flow into Lower Crow Reservoir. North Crow Creek is a steep gradient, high velocity pristine mountain stream when it emerges from the Mission Mountains. As it turns south it enters a canyon that has undergone some recent rural subdivision activity. It then descends into an agricultural region east of Highway 93. At this point Crow Creek has very little gradient and moves much more slowly. It then turns westward and contiues through the valley south of Ronan where it picks up Spring Creek.

Spring Creek begins as a natural spring two miles northeast of the Town of Ronan and flows through the middle of town. It receives urban storm water runoff and possibly some sanitary wastes and individual disposal system drainage as it flows through town. A dairy located in Ronan has been discharging (Montana Discharge Permit No. Mt0000108) to the creek with pronounced affect for some years. A recent compliance order dictates that the dairy will discharge only cooling water to Spring Creek and cease any further process discharges. After the confluence with Spring Creek, Crow Creek flows through a deep gorge traversing agricultural and pasture lands until it enters lower Crow Reservoir. The FD 208 Agency during their inventory of livestock feedlots and confinement area identified four small (0.5-2.0 acre) private units that drain into or abut North Crow Creek.

Mud Creek flows from the Mission Mountains through the agricultural lands on the east side of Highway 93. After crossing the highway it picks up a major unnamed tributary which, during the irrigation season, is composed primarily of irrigation return flows. A number of springs and small tributary streams , some of which are utilized by commercial fish hatcheries, enter Mud Creek below the highway. From Highway 93 Mud Creek continues through a valley with high concentrations of cattle until it reaches Lower Crow Reservoir. West Miller Coulee is composed almost entirely of irrigation return flows originating in the very barren and erosive country to the northwest. Like Mud Creek, this drainage has a number of cattle and confined livestock feeding areas, especially along the creek bottoms.

Lower Crow Reservoir is utilized to store irrigation water for the Moiese area. The water which enters the reservoir is very rich in nutrients and as a consequence, supports productive fishery and is subject to problem algal blooms in the fall. Water leaving Lower Crow Reservoir can flow either into the Flathead River or be diverted to Moiese for irrigation purposes. During a normal irrigation year, the flow to the Flathead River is shut off entirely.

The total drainage area of Crow Creek is 78,000 acres of which approximately 50 percent is irrigated, this estimate does not include Moiese Valley. No specific water quality problems were identified in the State's Water Quality Inventory and Management Plan (303e) for the area.

LITTLE BITTERROOT DRAINAGE

The flow of the Little Bitterroot River from Bitterroot Lake is controlled by the Flathead Irrigation Project. Near its origin the river flows through heavily wooded lands and has a considerable number of beaver dams and backwaters as it winds through marshy country. As the river continues south, it flows through Hubbart Reservoir and into very dry and arid country to the southeast. The average annual rainfall in this area is only 10-12 inches. The Camas Prairie and Little Bitterroot Valley is made up generally of heavy poorly drained soils, high in alkaline salts. The soils in this region have been characterized as the most highly erosive in the study area. Overgrazing has been a prevalent practice with resulting sheet and gully erosion. Severe continued overgrazing, low rainfall, and the resultant limited vegetative cover serves to aggravate the already serious erosion problems.

The river is heavily used for irrigation and picks up irrigation return flows. Due to the condition of the land through which it flows and the irrigation return flows it picks up, the Little Bitterroot carries a high sediment load when it reaches the Flathead River. An active lead mine has also been cited as a possible source of pollutants. High zinc concentrations have been found in tributary drainages to the mainstem of the Bitterroot River and in the tissue of fish sampled in the drainage.

SECTION 4

WATER QUALITY ANALYSIS AND EVALUATION

The collection and analysis of water quality data from the 208 study area has historically been primarily restricted to lakes and streams in Flathead County. The available information summarized in the Water Quality Inventory and Management Plans for the Lower Clark Fork River Basin shows only limited water quality data for the tributary's drainage in the Mission and Jocko Valleys. This information was limited to three or four grab samples taken between March and November in 1974 at five locations. The upper Flathead drainage basin has been the subject of a great deal more interest, in terms of instream water quality, but detailed information on a continued basis is available for the streams under consideration in this study only for November 1972 through October 1973 (Appendix A).

In general, water quality throughout the upper Flathead drainage is good. The rivers and streams selected for consideration in this investigation, with the exception of the Flathead River itself, constitute the largest, draining the major centers of intense man-oriented activities in the Flathead County.

SIGNIFICANCE OF WATER QUALITY PARAMETERS

The drainages studied in the southern portion of the Flathead 208 Study Area were restricted primarily to the intensive agricultural use areas of the Mission, Moiese and Jocko Valleys which drain directly to the Flathead River. While little investigative analysis has been performed on these systems, the present study indicates a broad spectrum of existing conditions ranging from pristine mountain lakes to highly polluted agricultural and urban drains. At the time this document was being prepared, the 208 agency's water quality monitoring efforts were still underway.

Between 14 and 16 parameters were measured at each sampling station. Because of the difficulty and inherent problems in evaluating one year of data on such a wide variety of parameters, this discussion is limited primarily to six key parameters including total suspended solids, nitrogen, phosphate, COD, Fecal coliform, specific conductance and ammonia where available. While a graphical interpretation of all sixteen parameters is available in a separate Data Appendix, this report presents a summary of available information in a tabular format in terms of average, and the high and low readings in Tables 4-1 through 4-7.

The purpose of this section is to present the results of the monitoring and analysis programs on a stream segment-by-stream segment basis. The six key parameters that will be discussed in detail were selected because they provide a relatively definitive indication of any major changes in water quality that could be expected within the Flathead and Lower Clark Fork Basins. While such elements as dissolved oxygen, anionic and cationic salts, and alkalinity may be important in a long-term analysis program, which this study will hopefully form the nucleus of, they were not shown to demonstrate enough variability to detect any significant alteration of water quality. The significance of the six major parameters are discussed below.

TOTAL SUSPENDED SOLIDS

Total Suspended Solids (TSS) are those materials that remain as particulate suspended material in the flow regime of a water body. They include materials introduced both from point and nonpoint sources including such things as wastewater effluent, erosion runoff, resuspended streambed load and almost any other form of solids or sediment that are introduced. TSS is significant in that it can, among other things, reduce the penetration of light and thus the aquatic photic zone, effect fish propagation by covering bottom spawning areas, reduce or change the diversity of benthic bottom dwelling invertebrates, increase water temperature by solar absorption and have an overall negative impact on cold water fishery. Aside from the aesthetic impacts of the toxicity of the material, TSS concentration over 90 mg/l has been shown to have an adverse affect on trout and other cold water fish (McKee and Wolf, 1963).

SPECIFIC CONDUCTANCE

All substances in solution in water collectively exert osmotic pressure on the organisms living in it. Most species can tolerate some changes in the relative amounts of salt normally present. Wide variations in salt content, however, can have far-reaching effects on stream fauna and flora. Natural inland waters usually contain small quantities of mineral salts, but in polluted waters the salt concentration may rise to levels harmful to living organisms. When the osmotic pressure is sufficiently high because of salts in solution, water may be drawn through the gills and other delicate external organs of fish with considerable cell damage or death.

In studies of water used for irrigation and fish production, the residue in solution or salinity is often expressed as specific electrical conductance. The specific conductance of streams and rivers supporting a good mixed fish fauna can range from 150 to 500 micromhos per cm, while waters with specific electrial conductance between 2,000 and 3,000 micromhos per cm are limited to unsuitable for irrigation purposes under most conditions. In waters supporting a good cold water fishery five percent had a specific conductance under 50 mhos, 50 percent under 270 mhos and 95 percent under 100 mhos.

NITRATES

Nutrients are an important limiting factor in the growth of all plants. With all other factors equal, the rate of plant growth is proportional to the amount of nutrients available. This is particularly the case for nitrogen and phosphorous which are thought to be the limiting factors to algal growth in many lakes and rivers and most estuarine and coastal waters. High nutrient concentrations in effluents and water, which are generally the result of man's acceleration of the process of eutrophication, can also stimulate the growth of plankton and aquatic weeds. Excessive "blooms" of these plant species can contribute to unpleasant tastes and odors in domestic water and to the eventual deoxygenation of instream water as a result of anaerobic bacterial decay. In irrigation canals excessive algal buildup can affect the hydraulics of the delivery system. Nitrate levels less than 1.0 mgd are generally considered desirable to maintain a good fishery but this is dependent upon a number of interrelated endemic factors. Nitrate salt concentrations above 500 mg/l are not recommended for stock watering.

CHEMICAL OXYGEN DEMAND

Organic wastes are decomposed by bacterial action. Bacteria attack wastes dumped into water bodies, using up oxygen in the process. These organic wastes can be measured in units of biochemical oxygen demand (BOD) or chemical oxygen demand (COD), both measures of the amount of oxygen needed to decompose them.

Chemical oxygen demand (COD) provides a measure of the oxygen equivalent of that portion of organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. Only by depressing the D.O. content to levels that are detrimental to aquatic life and other beneficial uses does COD exert a direct effect. It is then, when loads are so great that large amounts of oxygen are spent in their decompostion, that only the pollution-resistant fish (e.g. carp, suckers, etc.) can live in that body of water. Chemical oxygen demand is therefore one of the better chemical measurements of the ecological condition of the water.

PHOSPHORUS

Phosphorus is an essential element to the growth of organisms and can often be the nutrient that limits the growth which a body of water can support. Phosphorus occurs in natural waters and wastewaters almost entirely as various forms of phosphates. These forms are commonly classified as orthophosphates, polyphosphates and organically bound phosphates. Together they are collectively termed total phosphates.

The dominant source of phosphorus in subsurface and surface waters is through domestic wastes. Phosphates in detergents account for approximately 50 percent of this total, but this is being reduced as commercial products change. Phosphates in ground and surface waters are also the result of leachings from minerals and ores in the natural processes of degradation, from agricultural drainage and from industrial wastes. In surface waters, however, phosphates are seldom found in significant concentrations because they are utilized by aquatic plant species during the processes of photosynthesis. Phosphate concentrations in excess of 0.2 mg/l are generally thought to stimulate the growth of algae and aquatic plants in fresh water impoundments. The highest concentrations of phosphate are more likely to occur in groundwaters that receive leachings from fertilizer applications, from cesspool and septic tank drainage and from other organic waste sources. The fate of phosphate in either surface or groundwaters is highly debatable because of the affinity of most inorganic phosphate to attach to mineral sediment and soils. The availability of phosphate for living processes is often quite limited.

FECAL COLIFORM

Fecal coliform is harmless enteric bacteria found in the gut of warm-blooded animals. Their presence in water is an indication of fecal (human or other warm-blooded animals) discharge into water. The organisms are present in large numbers in waste products, making their detection quite easy. If fecal contamination is detected, it can be assumed that a potentially pathogenic organism may also be present along with the coliform bacteria. The absence of these organisms implies that recent intestinal discharges are not present in water and that the water is free of pathogens. Fecal coliform is an indicator organism, which should alert one to possible presence of waste contamination. It is very significant because water is a potential carrier of disease-causing or pathogenic bacteria and can endanger public health and welfare. The pathogens most frequently transmitted through water are those responsible for infections of the intestinal tract, as well as those responsible for polio and infectious hepatitus. Historically, the prevention of these diseases was the primary reason for water pollution control.

AMMONIA (NH_3) (LIMITED SELECTIVE ANALYSIS)

In the pure form, ammonia is a colorless gas with a pungent odor and is made synthetically from atmospheric nitrogen and hydrogen. Ammonia is the primary decomposition product from organic nitrogen (plant and animal proteins) under reducing conditions. In surface and ground waters known to be unpolluted, it is present in concentrations of less than 0.2 ppm. In the presence of oxygen, however, ammonia is immediately transformed by nitrifying bacteria into nitrate. For this reason, ammonia is considered indicative of recent pollution. Surface waters contaminated through human or animal activities generally contain nitrogen in the form of ammonia. Ammonia may be the result of effluent discharge from sewage treatment plants or from discharge of industrial or certain agricultural wastes.

Ammonia is known to occur in two forms in water, as ionize NH_4+ and unionized dissolved NH_3 gas. Unionized ammonia has been shown to be toxic to fish and other aquatic life in concentrations as low as 0.02 mg/l NH_3-N. Ionized ammonia is considered only a fiftieth as toxic, and thus of less direct impact on the aquatic habitat. The relative concentration between the ionized and unionized forms is dependent upon the equilibrium conditions which are established. This depends on both pH and temperature. In natural water the ionized form normally accounts for 95 percent or more of the total available ammonia. Ammonia determinations were made on Ashley Creek, and the Whitefish and Stillwater Rivers.

ASHLEY CREEK

A review of the summary of Ashley Creek water quality (Table 4-1) indicates a general increase in the average concentration of key pollutant constituents sampled downstream from Ashley Lake. Total suspended solids increased

TABLE 4-1

ASHLEY CREEK

Station		Temp.	TSS	NO3	TP	COD	DO	F.C.	Alk.	S.C.	Ca	Na	Cl	K
1.	Avg.	14.3	.58	<1	.018	10.9	8.85	51	120	228	11.3	1.6	<2	1.83
	High	19	1.5	<1	.04	17.6	10.2	248	131	240	19	6	<2	9
	Low	10*	0	<1	<0.01	5.9	7.8	2	105	190	4	<2	<2	<2
2.	Avg.	10.5	1.57	<1	.034	17.0	9.8	52	144	266	13.2	1.8	.57	1.28
	High	15.5	5	<1	0.10	43.9	11.6	150	156	280	36	7	2	4
	Low	4	0	<1	.01	5.8	9.2	10	136	260	2	<2	<2	2
3.	Avg.	11.7	3.14	<1	.058	13.77	8.7	78	117	204	16.2	2.1	.57	1.28
	High	17	10	1	.09	23.3	11.0	180	140	270	34	7	2	5
	Low	4	0	<1	.01	2.0	5.3	25	98	140	5	<2	<2	<2
4.	Avg.	13.2	5.5	1	.072	28.4	7.04	219	109	210	11.4	2.5	.85	1.28
	High	19	15	1	.18	34.9	10.8	800	141	280	34	7	2	3
	Low	6.5	0	1	.02	17.6	5.9	14	93	160	2	<2	<2	2
5.	Avg.	12.5	7.14	1	.052	20.88	9.5	66	131	249	13.1	3.2	1.57	1.57
	High	18	17	1	.11	31.6	11.4	160	161	290	34	11	3	3
	Low	7	0	<1	.02	5.9	8.2	10	107	170	3	<2	<2	<2
6.	Avg.	13.3	13.8	1.5	.046	23.6	9.5	120	160	306	13.2	3.8	2.14	2.42
	High	18	37	2	.06	58.7	11.2	300	188	360	34	11	4	4
	Low	8	6	1	.02	5.9	8.4	27	125	200	4	<2	<2	<2
7.	Avg.	14	21.1	3.25	0.558	20.7	7.4	2,401	163	327	18.8	4.8	8.42	3.28
	High	20	57	8	.81	31.0	10.0	12,700	186	410	32	10	15	8
	Low	8.5	2	<1	.26	9.8	5.3	76	129	180	9	<2	2	2
8.	Avg.	14.1	14.8	7	0.758	20.6	6.74	2,254	172	370	19	7.28	13.1	3.5
	High	20	43	12	1.04	31.0	14.3	12,200	196	440	32	19	23	7
	Low	9	5	3	.25	9.8	3.0	14	132	220	11	<2	4	2

* Could not sample 4/28/76

approximately 360 percent between Station 1 at the outlet to Ashley Lake and Station 7 below the sewage treatment plant. Station 8 (Figure 1-2) is effected by a low gradient (slow moving water), and backwater from the Flathead River causing sedimentation of particulate matter in the streambed. COD increased from an average low concentration of 10.9 mg/l leaving the lake, to a high of 28.4 mg/l from waters flowing from the highly organic Smith Lake. From Stations 5 through 8 the COD remained almost constant. Nutrients, nitrate and phosphate, followed no definite pattern. Nitrate increased from the limits of detectibility (1 mg/l) at Station 5 to a high average of 7 mg/l at the confluence with the Flathead River. Phosphate peaked at Smith Lake and again below the Kalispell sewage treatment plant. Fecal coliform normally remained within the established state standards until the point of discharge with the sewage treatment plant. Below this point, the concentration of coliform organism was extremely high on several occasions. This could possibly indicate problems in the chlorination equipment of the sewage treatment plant. Coliform concentrations increased where Ashley Creek leaves Smith Lake's marshy outlet which is used extensively for pasturing cattle throughout the summer.

The information collected during this investigation substantiated in part the conclusions in the state's Management Plan. Ashley is indeed greatly influenced below the City of Kalispell by secondary effluent from the wastewater treatment facilities. In addition, the highly eutrophic Smith Lake, and its associated land use, is responsible for adding organic matter and solids. The overall effect of Smith Lake may be both positive and negative. It may act both as a source and a depository of material serving as a settling basin removing some suspended matter and nutrients during periods of low flow, but resuspending a portion of this during the spring runoff.

Seasonal ammonia toxicity problems, below the sewage treatment plant, were discussed in the Flathead River Basin Plan (303e) as a cause in the decline in the trout and salmon migration run out of Flathead Lake. The FD 208 Agency ran diurnal ammonia and dissolved oxygen on July 22-23 and August 19-20. While these are not critical low flow periods nor the normal migration season, they have historically been lower flow periods when the town has experienced its highest seasonally influenced wastewater flows. Utilizing the method proposed by the EPA Region VIII (Ammonia Toxicity, 1976) the peak unionized ammonia and oxygen concentrations were computed from total ammonia determinations made at the Ashley Lake outlet and below the Kalispell sewage treatment plant. The following results were obtained:

	July 22-23 Station		August 19-20 Station		November 15 Station
	1	7	1	7	7
Total peak ammonia mg/l	0.20	0.43	0.20	0.75	0.4
% NH_3 (unionized)	3.8	3.1	2.5	2.3	0.5
NH_3 mg/l (unionized)	0.008	0.014	0.005	0.017	0.002
O_2mg/l	8.2	5.7	8.3	5.3	-

From experimental data the EPA paper summarized that the "maximum permissible in-stream concentration of unionized ammonia should not exceed 0.02 mg/l" as unionized ammonia for waters classified for fishery use. While the calculated ammonia did not reach this toxic level during our investigation, it could during critical low flow. Flow measurements were not made on Ashley Creek by the FD 208 Agency during these investigations. However, from USGS data collected over the preceding five years it appeared possible for the flow to decrease by a factor of 4 between July and late October. This would indicate that unionized ammonia could reach as high as 0.068 mg/l if all factors were to remain the same. This is within the experimentally derived toxic level for prolonged exposure (24-48 hours) for salmonoid species. A single set of phenol analysis was performed at each of the Ashley Creek sampling stations in November of 1976 by the FD 208 Agency. Concentrations ranged from <1 to 7 micrograms per liter and averaged 3.5 micrograms per liter. Domestic consumption and instream standard for phenol is 1 microgram per liter (EPA, 1976). A second set of phenol samples were collected after this report was prepared for printing. The results are shown in Appendix 3.

Phenol Concentrations
(November 3, 1976)

Sample Station Ashley Creek	Concentration (micrograms/liter)
1	2.5
2	3.5
3	1.5
4	2.5
5	>1
6	7.0
7	6.5
8	1.5

Other factors that should be considered in the analysis of the Ashley Creek drainage are the impacts that second home and recreation developments along the shores of Ashley Lake can have on the quality of the overall system. This study was not designed to specifically identify problems that could be attributed to this subdivision activity, however, the higher than expected average coliform concentration at Station 1 is quite likely partially the result of malfunctioning individual waste disposal facilities along the lake. Burlington-Northern (BN), who owns and leases (10 year lease) the available land on Ashley Lake has indicated that no further leases will be given and that those present lease holders will be phased out as they come up for renewal. If BN maintains this direction any problem resulting from this type of activity should gradually improve.

STILLWATER RIVER

The Stillwater is of relatively high quality throughout. There are no known point discharges and due to the exclusive use of spray irrigation almost no direct agricultural runoff. Natural late summer and fall low flows aggravated by increasing irrigation pumping has created a number of problems related to fish propagation and movement. The summary of water quality data presented in Table 4-2 indicates that the lower Stillwater remains in almost the same condition throughout its course down the Flathead Valley. The only parameters of significance are the steady increases in average total suspended solids (2.8 - 38.3 mg/l) and Fecal coliform (6 - 77 organisms/100 ml). Sediment and suspended solids can be attributed to the basic instability of the stream bank soils and the suspension of sloughed material compounded by irrigation and some minor return flow. The increase in coliform organisms are a result of cattle operations in the valley, and to some extent the impacts of urban development and runoff from the Kalispell area. This data bares out most of the conclusions presented in the Flathead River Basin Management Plan.

Ammonia analysis performed for the three lowest sampling stations on the Stillwater on September 21, shows the highest concentration of unionized ammonia to be less than 0.01 mg/l as NH_3-N, far below the conservative toxic level according to EPA sources.

WHITEFISH RIVER DRAINAGE

The Whitefish River is, according to the data collected during this study (Table 4-3), divided into two zones of influence by Whitefish Lake. Swift Creek entering the lake

TABLE 4-2

STILLWATER RIVER

	Station	Temp.	TSS	NO_3	TP	COD	DO	F.C.	Alk.	S.C.	Ca	Na	Cl	K
1.	Avg.	13	11.67	<1	0.15	3.65	9.18	13	87	156.33	17.60	1.40	<2	1.80
	High	16	25	<1	0.7	8	10.5	43	110	210	35	5	<2	9
	Low	9.5	0	<1	<0.01	<2	7.8	1	71	63	8	<2	<2	<2
2.	Avg.	16.5	2.67	<1	0.13	4.52	9.3	5	77	152.33	21.67	1.33	<2	2.67
	High	20.5	11	<1	0.6	11.6	10.8	11	100	180	38	4	<2	8
	Low	11	0	<1	<0.01	<2	7.6	0	83	94	6	<2	<2	<2
3.	Avg.	16	4.42	0.20	0.19	2.80	9.27	27	86	148.17	22.67	1.33	<2	2.83
	High	20	11	1	0.8	5	10.5	160	110	170	38	4	<2	[illegible]
	Low	11	0	<1	<0.01	<2	8.6	7	72	89	7	<2	<2	<2

TABLE 4-3

WHITEFISH RIVER

Station		Temp.	TSS	NO3	TP	COD	DO	F.C.	Alk.	S.C.	Ca	Na	Cl	K
1.	Avg.	15	2.75	<1	0.07	5.65	8.60	6	109	190	14.17	.50	<2	<2
	High	19	12	<1	0.30	11.6	9.7	28	114.0	220	20	3	<2	5
	Low	11	0	<1	0.01	<2	7.5	0	105.5	120	3	<2	<2	<2
2.	Avg.	15.13	7.75	<1	0.12	6.82	8.5	37	113	203	16.50	0.33	<2	<2
	High	19	16.5	<1	0.50	11.8	9.7	690	123	250	30	2	<2	4
	Low	9	0	<1	0.01	<2	7.4	30	107	98	7	<2	<2	<2
3.	Avg.	16.25	19.17	<1	0.10	5.77	7.95	50	114	205	16.33	0.33	<2	<2
	High	22	76	<1	40	11.8	9.2	77	132	260	30	2	<2	4
	Low	10	0	<1	0.01	<2	7	16	97	100	5	<2	<2	<2
4.	Avg.	13	38.25	<1	0.12	6.17	8.45	77	112	205	17.17	3.17	0.83	<2
	High	17	87	<1	0.40	11.8	9.3	1,410	131	260	32	15	3	5
	Low	10	3	<1	0.01	<2	7.7	370	100	100	3	<2	<2	<2

from the forested lands to the north is as high or higher in total suspended solids, phosphate and COD than any point sampled along the river. Fecal coliforms concentration, however, are lower than the two downstream stations. This would indicate that land use activities and/or natural geologic characteristics are combining to generate a significant amount of pollutant material entering Whitefish Lake. From this data it appears, in contrast to the conclusions in the 303e plan, that logging and other activities (i.e., recreational) in the upper drainage may be a more important source of solids and phosphate than previously considered. Suspended sediment data being collected (1975-1976) by the Montana Department of Natural Resources and Conservation in connection to logging activity in the Swift Creek drainage showed a range of values between 1378 and 2.5 mg/l for the same sampling period. This data indicated a close correlation between discharge (flow) and total suspended sediment, that is, the higher the runoff the greater the solids concentration (Bengeyfield, 1977).

While much of this phosphate and sediment entering the lake is removed by natural processes, the eventual fate of this material is unknown. Fecal coliform concentration increases as the river gets closer to Kalispell. Suprisingly, this increase is not evidenced below the Whitefish Wastewater Treatment Plant as would be expected, but instead at the confluence with the Stillwater above Kalispell. The concentration of Fecal coliform organisms at this station violated the state's water quality standards (200/100 ml) a number of times during 1976.

An analysis for unionized ammonia during September at the three lower monitoring stations (Stations 2, 3, and 4), revealed concentrations far below the accepted toxic levels (less than 0.01 mg/l). This study did not sample directly below the Whitefish Wastewater Treatment Plant.

SWAN RIVER DRAINAGE

The Swan River had the highest overall quality of any system monitored (Table 4-4). Similar to the Whitefish, the water entering Swan Lake is higher in total suspended solids than any place on the river. These higher average sediment loadings are due in all probability to surface runoff from disturbed soils in the drainage. While the sediment concentrations measured in this study are low, any extensive increase in logging may, unless carefully controlled, have the potential of creating water quality problems and increasing the fill-in of upper Swan Lake and possibly the reservoir.

TABLE 4-4

SWAN RIVER

Station		Temp.	TSS	NO_3	TP	COD	DO	F.C.	Alk.	S.C.	Ca	Na	Cl	K
1.	Avg.	9	62	<1	0.14	4.03	10.43	5	81	189	16.67	<2	<2	2.83
	High	12	316	<1	0.60	7.8	11.6	12	107	230	33	<2	<2	17
	Low	6	1	<1	0.01	2	9.4	0	65	67	6	<2	<2	<2
2.	Avg.	15.3	13	<1	0.11	4.23	9.3	61	84	154	14.67	0.67	<2	2.17
	High	20	51	<1	0.50	11.8	10.7	153	86	180	34	2	2	13
	Low	9	0	<1	0.01	<2	8.1	6	79	82	<2	<2	<2	<2
3.	Avg.	15.1	21.17	<1	0.11	3.23	8.28	185	91	164	20.50	3.67	<2	2.00
	High	19.5	76	<1	0.13	8	9.4	500	97	200	35	22	2	12
	Low	10	1	<1	0.01	<2	7.5	39	82	84	11	<2	<2	<2

The concentration of all parameters measured at the three Swan River stations were low and reflected the type of water quality that would be expected from a drainage with particular pristine characteristics. The Swan drainage has not been subjected to the levels of subdivision activity seen in many of the other smaller lakes in the study area.

In summary, from a water quality standpoint, little can be said about the Swan except that it is of exceptional quality. It should be noted, however, that the Swan River Drainage could be subject to rapid degradation unless adequate controls are established to manage logging, subdivision, and construction activities in order to protect its watershed from unrestricted exploitation. The dam and impoundment on the lower reaches of the Swan River were not subject to analysis during this study. However, it should be pointed out that it poses not only an obstruction to fish migration, but could serve as a stilling basin and sediment and nutrient trap if these materials were generated in the basin.

JOCKO RIVER DRAINAGE

The Jocko River, with only one major exception, is the only relatively simple closed drainage in the lower Flathead Valley. The only significant tributary to the Jocko within the study area is Finley Creek which flows out of Missoula County and intersects with the Jocko below Arlee. The Mission, Post and Crow drainages are composed of a myriad of intricate, and in a number of cases cross-connected streams, irrigation canals, and drains which have for the most part been integrated as part of the natural drainage system.

As indicated by the summary of monitoring information, (Table 4-5) the water quality of the Jocko follows a rather straightforward pattern. The key parameters we are considering, increased or remained nearly constant from the headwaters of the Jocko down to its confluence at Dixon.

The impact that Finley Creek has on the Jocko is quite evident in reviewing the sample data between Stations 1 and 3, and comparing it to the water quality on lower Finley (Station 2). Flow in Finley ranged from a high of 146 cfs to a low of 10 cfs with an average seasonal discharge of approximately 60 cfs. This compares to an average seasonal flow in Jocko of approximately 185 cfs (250 high 85 low). While the water in Finley Creek is obviously detrimental to the overall quality of the Jocko, its flow is significantly less.

TABLE 4-5

JOCKO DRAINAGE

Station		Temp.	TSS	NO_3	TP	COD	DO	FC	Alk.	S.C.	Ca	Na	Cl	K
1.	Avg.	8.09	1.45	0.43	.017	2.7	10.4	5	97.4	185.4	18	<2	<2	1.18
	High	10.5	3	2	.03	7.7	11.4	10	117	240	100	8	<2	9
	Low	5	0	<1	<0.01	<1.5	9.9	1	80	140	3	<2	<2	<2
2.	Avg.	11.09	11	.85	.05	9.88	9.8	1723	81.75	146.1	12.5	<2	<2	1.58
	High	16	38	2	.09	17.5	11.1	10500	146	200	59	16	4	6
	Low	6	2	<1	.02	<2	8.9	138	56	34	<2	<2	<2	<2
3.	Avg.	10.4	4.0	.7	.037	3.4	10.3	69	118	223.3	16.6	2.3	<2	1.4
	High	14	14	2	0.1	7.7	11.1	300	134	260	100	19	2	8
	Low	7	0	<1	<0.01	<2	8.9	13	89	180	3	<2	<2	<2
4.	Avg.	11.25	6.9	0.43	.024	3.9	10.5	41	126	234.1	17.25	2.3	<2	916
	High	15	25	2	.08	18.8	11.4	76	143	280	95	26	2	7
	Low	7	0	1	0.01	2	9.2	11	100	190	2	2	2	2
5.	Avg.	11.6	7.8	0.43	.03	3.40	10.3	46	127	244.1	15.3	1.4	2	1.5
	High	15.5	30	2	.07	17	11.3	76	144	300	95	10	2	7
	Low	7	0	<1	0.01	<2	9.2	18	99	160	<2	<2	<2	<2

Overall, the Jocko River is of high quality, exceptionally so relative to many other streams in the Lower Flathead Valley. Pollutant constituents increase in relation to the river's exposure to human related activities along its drainages, but the extent of this degradation is minor.

MISSION AND POST CREEK DRAINAGES

Mission and Post Creeks originate high in the Mission Mountains, where they are impounded and controlled for irrigation supply by Mission, Tabor (which also includes flow from Jocko River drainage), and McDonald Reservoirs respectively. Mission and Post flow together east of the headquarters of the National Bison Range and as Post Creek empties into the Flathead River near Moiese. Between the origin and final confluence with the Flathead River the streams are subject to a number of intervening water quality impacts. The main Pablo Feeder Canal diverts water from Dry Creek, below Tabor Reservoir, and continues north for almost 42 miles picking up waters from Mission and McDonald Reservoirs. The canal provides irrigation water for lands along its alignment as well as providing storage for Kicking Horse and Ninepipe Reservoirs before terminating at Pablo Reservoir. Annually only about 2.5 percent of the potential flow from these three reservoirs is allowed to spill into their natural stream channels, the remainder of the water in Mission and Post Creeks is made up of irrigation runoff and return flow, natural rainfall and springs in the upper portion of Post Creek. During the monitoring period preceding preparation of this report (May - September) the average flow into Mission Creek (Mission plus Tabor overflow) was approximately 26 cfs. During the same period, the mean flow into Post Creek from McDonald Reservoir was 28 cfs. Post Creek picked up roughly another 150 cfs from springs below highway 93 and approximately 30 cfs from irrigation returns from Hillside Reservoir (Station 1) and Dublin Coulee (Station 8).

Table 4-6 summarizes water quality information collected from monitoring stations in the Mission and Post Creek drainage. Generally mainstream water quality deteriorates as you progress down the drainage. At the outlet of McDonald, Station 14 had extremely high water quality. Below the confluence of Mission and Dry Creeks, Station 12 was established at a point that had already been affected by localized drainage, assuming the waters from Tabor and Mission Reservoirs should reflect a water quality similar to McDonald. Stations 10 and 11 and Sabine and Mission Creeks below Saint Ignatius both show a sharp increase in Fecal coliform organisms that would be expected since both

TABLE 4-6

MISSION/POST DRAINAGE

Station		Temp.	TSS	NO3	TP	COD	DO	FC	Alk.	S.C.	Ca	Na	Cl	K
6.	Avg.	14.13	34.7	1.71	.104	15.3	9.8	1401	140.5	254	12.25	4.08	4.0	2.75
	High	20.5	118	4	.25	30.7	10.8	4200	160	320	80	17	13	7
	Low	7	0	<1	.02	<2	8.7	170	112	150	2	<2	2	<2
7.	Avg.	15.72	51.9	1.0	.123	24.5	8.8	2703	146.2	242	9.16	4.6	8.25	4.5
	High	22	199	1	.20	35.9	10.1	10300	222	450	45	30	15	15
	Low	7	0	<1	.05	11.6	8.1	130	93	110	<2	<2	<2	2
8.	Avg.	16.05	20.5	1.57	.137	28.28	8.35	1849	146.6	272.5	10.16	6.08	12.1	5.5
	High	22	72	3	.23	49.8	10.0	7600	253	540	45	30	28	13
	Low	7	0	<1	.05	15.4	6.4	78	86	80	2	2	6	<2
9.	Avg.	13.5	23.6	1.265	.083	11.5	8.7	1030	140.36	252	14.4	4.7	<2	2.0
	High	18	95	2	.22	47	10.9	2100	165	290	70	25	5	5
	Low	7	2	<1	.01	<2	7.8	400	102	190	<2	<2	<2	<2
10.	Avg.	13.0	16.9	1.285	.048	8.66	10.8	652	174	301	13.25	4.2	4.2	1.36
	High	16	62	3	.08	17	13.6	3300	220	360	55	29	7	5
	Low	8	<1	<1	<.01	3.8	8.7	86	166	175	<2	<2	<2	2
11.	Avg.	10.5	16.8	.85	.055	2.25	9.9	852	110	200	18.5	2.0	<2	1.46
	High	13	163	2	.11	11.9	10.7	3300	136	250	75	20	3	4
	Low	8	<1	1	.01	2	8.8	6	75	110	3	<2	2	2
12.	Avg.	10.5	8.4	.571	.036	3.5	10.06	93	59	132	18.9	2.3	<2	1.36
	High	13	68	1	.07	15.6	11.6	200	72	190	70	12	2	4
	Low	9	1	1	<.01	<2	9.5	23	48	80	3	2	2	<2
13.	Avg.	11.9	27.8	1.42	.084	14.4	9.5	1416	92	176.3	18.2	1.0	2	1.3
	High	16	99	4	.16	56	10.4	6100	130	260	75	7	3	4
	Low	7	2	<1	.04	<2	8	260	66	120	3	<2	<2	<2
14.	Avg.	10.0	0.75	1	.046	2.13	9.9	<1	72	160	18.2	2	2	1.5
	High	12	3	1	.12	10.9	10.8	1	103	310	75	2	2	5
	Low	8	<1	<1	<.01	2	88	0	60	130	3	2	<2	[illegible]
15.	Avg.	16.1	2.5	.57	.05	10.4	8.08	18	70.7	145	8.1	2.2	2	1.09
	High	22	12	1	.11	19.5	10.4	62	104	180	36	20	5	4
	Low	11	1	1	.04	2	57	0	55	170	<2	<2	<2	2

receive unchlorinated effluent from the sewage lagoons at Saint Ignatius and runoff from local grazing. Both stations likewise show an increase in nutrients (NO3 and total phosphate) and solids which again would be expected given the prevailing conditions. Station 9 on Post Creek before its confluence with Mission and Sabine is carrying a great deal more flow than Station 13 but has received not only agriculture drainage but the flow through discharges from several trout hatcheries that utilize the springs in the area. The water quality at Station 9 is very similar to that at Station 13 even though the flow has been increased approximately 6 times. Given this dilution factor, it would appear that the mass loading of pollutant material should also have been increased at a similar rate. Stations 7 and 8 demonstrated some of the lowest quality water in the system. Both are primary agricultural drains from the Charlo area, high in nutrients, silt, organic matter and fecal contamination.

Water taken from Ninepipes Reservoir (Station 15) is used to irrigate the area between Charlo and Post Creek. The water taken off Ninepipes is of a fairly good quality, low in total suspended solids, nutrients, and fecal bacteria. Much of the water coming off Ninepipes is used to irrigate the Charlo area and is picked up by the drain represented by Stations 7 and 8. While their overall contribution to the total flow of Mission Creek is relatively minor (20%), it would appear that they do exert some influence on the water quality of the system. The quality of Mission Creek at its confluence with Flathead near Moiese, has undergone a great deal of change from the waters that left McDonald Reservoir. While some of this change would occur naturally, even if the stream flowed through completely undeveloped lands, a great deal is undoubtedly a result of human oriented activity. Total solids, nutrients, organic matter, and bacterial concentration have all increased markedly (Table 4-6) in the approximately 18 mile course that Mission Creek takes on its way to the Flathead. While we have no records of what the water quality in the area was like prior to the advent of water and chemical intensive agriculture, residential development, and the use of confined pasturing, we do have an indication from long-time area residents, that many of the streams in the area did, at one time, support a fairly good cold water fishery which is no longer the case. Thus it would be reasonable to deduce that endemic conditions have changed and that the water quality of the region has followed this change.

Published water quality standards refer only to Mission Creek but include by description most of Post Creek. Within the areas sampled during this study the majority of

Mission Creek would be classified as B-D_2, while Station 12 and Upper Post Creek (Station 9 and 13) would be BD_1. Both Station 9 and 13 are in regular violation of the Fecal coliform requirements, and while turbidity was not measured, suspended solids data and field observation indicated the turbidity standards would also be in violation if it were possible to establish what the "naturally occuring" levels were. Of the remaining monitoring stations classified B-D_2, only 14 and 15 were not in violation of Fecal coliform standards.

CROW CREEK DRAINAGE

The Crow Creek Drainage, for the purpose of this evaluation, included the three stations (Stations 26, 27 and 28), that were established on streams and channels originating from Pablo Reservoir, and the single station (20) which was established at the confluence of the Little Bitterroot.

Pablo Reservoir supplies irrigation water for the land below Pablo National Wildlife Refuge including Valley View and the Round Butte area. The water diverted off the Reservoir through the Pablo"A" Canal (Station 28) is of a relatively good quality (Table 4-7), low in both suspended matter and Fecal coliform. Station 27 and 28 represent points near the termination of the two main branches of the system. Station 27 is made up of irrigation and drainage return flow from the Valley View area. Suspended solids, COD and Fecal coliform have all increased approximately seven fold over the concentration leaving Pablo Reservoir. In addition, alkalinity and specific conductivity were the highest measured at any point in the study. It should be noted that at this point the channel is composed almost entirely of return flow and canal spillage. This water will not normally empty into the Flathead River, but is usually lost by seepage before it can reach the river. The water sample at Station 26, while not as severely degraded as the site Valley View (Table 4-7), does carry a substantially increased suspended sediment and Fecal coliform load as compared to the water drawn directly out of the reservoir (Station 28).

The Little Bitterroot Station (Station 20) at Sloans Bridge was the only point on this drainage that was sampled. Average suspended solids concentration were the highest measured in the entire study area (over 144 mg/l). These solids concentrations were reflected in the higher water temperature and lower dissolved oxygen concentrations (Table 4-7) measured at this point. It is difficult to develop definite hypothesis on the impacts land use has on

TABLE 4-7

CROW CREEK DRAINAGE

Station		Temp.	TSS	NO_3	TP	COD	DO	FC	Alk.	S.C.	Ca	Na	Cl	K
16.	Avg.	11.7	1.3	1.0	.076	6.6	9.04	201	61.4	134.4	19.3	1.9	2	3.0
	High	18	6	1	.12	20.7	10.4	500	83	160	75	15	2	4
	Low	8	<1	<1	<.01	<3	6	86	56	99	3	<2	<2	.2
17.	Avg.	11.6	2.9	1	.235	28.2	9.41	3075	143.10	259	32.72	0.78	2.56	3.44
	High	17	10	2	.36	83	12	8300	169	300	130	5	9	12
	Low	9	0	<1	.13	<2	8	25	131	170	2	<2	<2	<2
18.	Avg.	14.9	16.2	1.2	.13	11.8	8.9	2930	114.35	207	17.50	1.44	2.78	3.39
	High	20	100	2	.20	35	10.2	16500	158.5	260	60	6	6	6
	Low	10	2	<1	.05	<2	7.4	95	76	150	<2	<2	<2	<2
19.	Avg.	15.25	11.9	1.28	.185	1.4	9.4	392	125.60	240	16.78	1.22	2.72	4.17
	High	19	47	2	39	38.3	11.7	3300	158.00	290	45	5	5	12
	Low	8	0	<1	.04	2.0	8.1	6	108.00	200	4	<2	<2	<2
20.	Avg.	17	144 4	2.42	.203	29.2	8.0	633	130.55	288	9.22	5.33	13.28	10.22
	High	26	283	7	31	47	8.6	1400	168	370	40	27.5	19	30
	Low	8	53	<1	.04	10.3	5.9	160	80	160	2	<2	5	2
21.	Avg.	13.2	31.5	2.85	.078	15.12	9	3388	187.10	310	14.78	3	5	7.11
	High	18	75	4	.26	31.1	9.4	7500	211	380	36	9	17	26
	Low	10.5	1	<1	.01	1.8	6.0	700	146	190	2	<2	<2	<2
22.	Avg.	15.09	80.8	2.3	.235	26.3	8.55	3901	137.50	268	11.83	4.56	5.56	9.04
	High	21	390	4	.48	50	10.1	12450	192	350	33	15	14	31
	Low	9.5	1	<1	.12	11.7	6.5	260	104	220	<2	<2	2	<2
23.	Avg.	9.2	2.9	1.14	.09	<2	10.3	106	132.90	251	15.39	89	<2	5.34
	High	11	21	2	.26	4.2	11.8	700	152	270	36	3	<2	15
	Low	8	0	<1	<.01	<2	9.5	4	120	240	2.5	<2	<2	<2
24.	Avg.	7.18	1.5	<1	.03	<2	10.8	31	36.40	106	9	2	<2	1.61
	High	12	8	1	.07	30*	10.8	30000	77	355	22	<2	<2	6.5
	Low	5	<1	<1	<0.01	<2	10.8	0	19	47	<2	<2	<2	<2

TABLE 4-7 (contd.)

	Station	Temp.	TSS	NO3	TP	COD	DO	FC	Alk.	S.C.	Ca	Na	Cl	K
25.	Avg.	11.2	10	1	.06	9	9.8	258	107	207	22	<2	<2	2.7
	High	17	29	2	.3	22.2	11.2	500	133	250	50	3	2	10
	Low	7	4	<1	<.01	1.9	9	19	77	150	3	<2	<2	2
26.	Avg.	15.8	17	1	.13	6.7	8.7	305	53	110	9	<2	<2	2.2
	High	20	71	2	.68	11.5	9.7	1600	63	120	30	2	<2	7
	Low	10	1	<1	<.01	3	6.5	3	48	95	<2	<2	<2	<2
27.	Avg.	16	27	<1	.51	36	9.4	2340	277	465	5	6.9	12.6	14.2
	High	24	73	2	.44	44.2	10.8	10100	415	570	20	19	28	40
	Low	10	3	<1	<.01	17.9	8.4	2	180	350	<2	<2	4.5	<2
28.	Avg.	15.7	10	<1	.06	6.3	9.5	35	56	100	6	<2	<2	3.4
	High	21	19	2	.10	13.4	10.6	66	67	110	27	<2	2	11
	Low	10	3	<1	<.01	2.6	7.7	2	46	55	<2	<2	<2	<2

* Most likely this is an anomaly.

water quality of the Bitterroot. There is no comparative data on the upper portions of the drainage. Groundwater samples in the Little Bitterroot drainage have indicated high lead concentration in the area. A single analysis of surface water (U.S. Fish and Wildlife Service, 1976) showed that lead, silver and zinc concentrations were well within the standards established for drinking water (50 micrograms/l).

The Crow Creek drainage which was investigated in detail at nine stations, is extremely complicated and subject to a variety of degrading point and nonpoint sources. Lower Crow Reservoir acts to remove some sediment and nutrients through physical and biological processes. The reservoir further complicates the analysis of water quality by regulating flows in the lower portions of Crow Creek. Crow Creek arises from three identified sources, the Pablo feeder canal and its irrigation drainage, the natural drainage from the Mission Mountains and springs in the Ronan area.

Stations 23 (Spring Creek) and 24 (upper Crow) are examples of highest quality water in the system. Spring Creek originates above the town of Ronan. North of the town several confined dairy operations drain into Spring Creek, along with the runoff from some limited residential development. As Spring Creek passes through Ronan it picks up municipal discharges and drainage along with the effluent from the Ronan Dairy. Spring Creek then flows into upper Crow Creek, after passing through a low gradient section south of town, carrying an average flow (during this study) of approximately 35cfs at the confluence with upper Crow Creek. In the estimated 5 miles between Stations 23 and 17 (confluence with Crow Creek) contributions from the various sources in and around Ronan have a marked influence on the nutrient, Fecal coliform, and COD load carried by the stream. In particular it should be noted that while the total suspended solid concentration remained the same, the total phosphate increased indicating that a large portion of the nutrient material is present either in the soluable form or as highly volatile organics which could be lost during drying. This along with the marked increase in organics material (COD) and Fecal coliform would indicate that localized point sources in Ronan are responsible for a good portion of this degradation.

The upper Crow Creek Station (24) has an average flow of approximately 11 cfs. As would be expected, this station had the highest quality water in the drainage. Between Station 24 and 16 upper Crow passes through agricultural lands and subdivided residential lands east of Ronan. Water quality data for these two stations shows a marked increase in total suspended solids, Fecal coliform, nutrients and COD.

Station 25 on upper Mud Creek was sampled at a point which lies east of the town of Pablo. Mud Creek's flow at this station averaged 3 cfs during the monitoring period. At Station 21 (lower Mud Creek) the average calculated flow was approximately 17 cfs. Since no other major tributaries join Mud Creek between these two stations, it would be assumed that this increased flow is made up chiefly of springs, natural drainage, and irrigation runoff and return flow. Water quality data between the two points showed a general increase in measured constituents.

Station 22, West Miller Coulee, flows are made up almost entirely of return drainage and discharges. As would be expected all six of the key parameters evaluated were high. Suspended solids, in particular, reached one of the highest levels measured during the study (average 81 mg/l) and had the highest individual peak of any station sampled (390 mg/l).

Station 19 at the outlet to lower Crow Reservoir, showed the effects of settling and bacteria removal the reservoir had on Crow Creek. Station 18 (Crow Creek) which comprises the majority of the flow into lower Crow Reservoir averaged 111 cfs and Stations 21 and 22 had relatively high concentrations of solids, nutrients and Fecal coliform.

Average Concentration

Station	TSS (mg/l)	Fecal Coliform	Flow (cfs)
18	16	2930	111
21	32	3388	17
22	81	3901	-

The water released from lower Crow Reservoir showed a significant decrease in the concentration of these parameters. Suspended solids were reduced by over 25 percent and Fecal coliform by over 85 percent over the dominant flow from Crow Creek (Station 18). Other parameters remained approximately the same as those measured at Station 18.

The State of Montana's Water Quality Standards for Crow Creek classify the majority of the mainstream as B-D_2. Stations 24 and 16 were classified B-D_1. The tributary drains to Crow Creek, which were monitored in this study and were classified B-D_1. Of the 13 sampling stations considered, only three (23, 24, 28) did not exceed the Fecal coliform requirement (200 organisms/100 ml). Stations 21 and 22 also failed to meet dissolved oxygen standards (7mg/l) on several occasions.

SECTION 5

DISCUSSION AND SUMMARY

How extensive is water pollution in the Flathead Valley, and what is the potential for further water quality degradation? These are complex and difficult questions and will require extended and careful analysis of the available data and that collected in years to come in order to unravel and define the interrelations between water quality and land use impacts within the various subdrainages. In order to facilitate this analysis, the two basic geographic areas considered in the proceeding sections, the Upper and Lower Flathead Valleys, have been maintained. Except for some notable exceptions (i.e., treatment plant effluent discharges, industrial point sources, and agricultural drains) the majority of the existing and, as it appears now, future pollution sources are nonpoint in nature. It is, therefore, even more difficult to precisely assess and quantify the cumulative effects of individual sources of pollution.

In order to simplify and graphically summarize the existing instream water quality conditions schematic diagrams were prepared to illustrate the average concentration of three parameters thought to reflect the major activities and natural pollution sources within the study area. Total suspended solids, Fecal coliform and nitrate were selected since it was felt that they respond to the effects of both urban and rural activities within the individaul drainages, as well as the contribution of natural sources.

Total suspended solid information provides a measurement of the amount of solute material present and the increase that can occur between sampling stations. Solids can be generated by natural processes, such as annual surface runoff, stream bank erosion, and movement of natural bed loads. It can be aggravated and increased by discharges of silt laden irrigation return water, municipal effluent, instream and stream side construction and disruptive activities (i.e., cattle watering) and urban runoff.

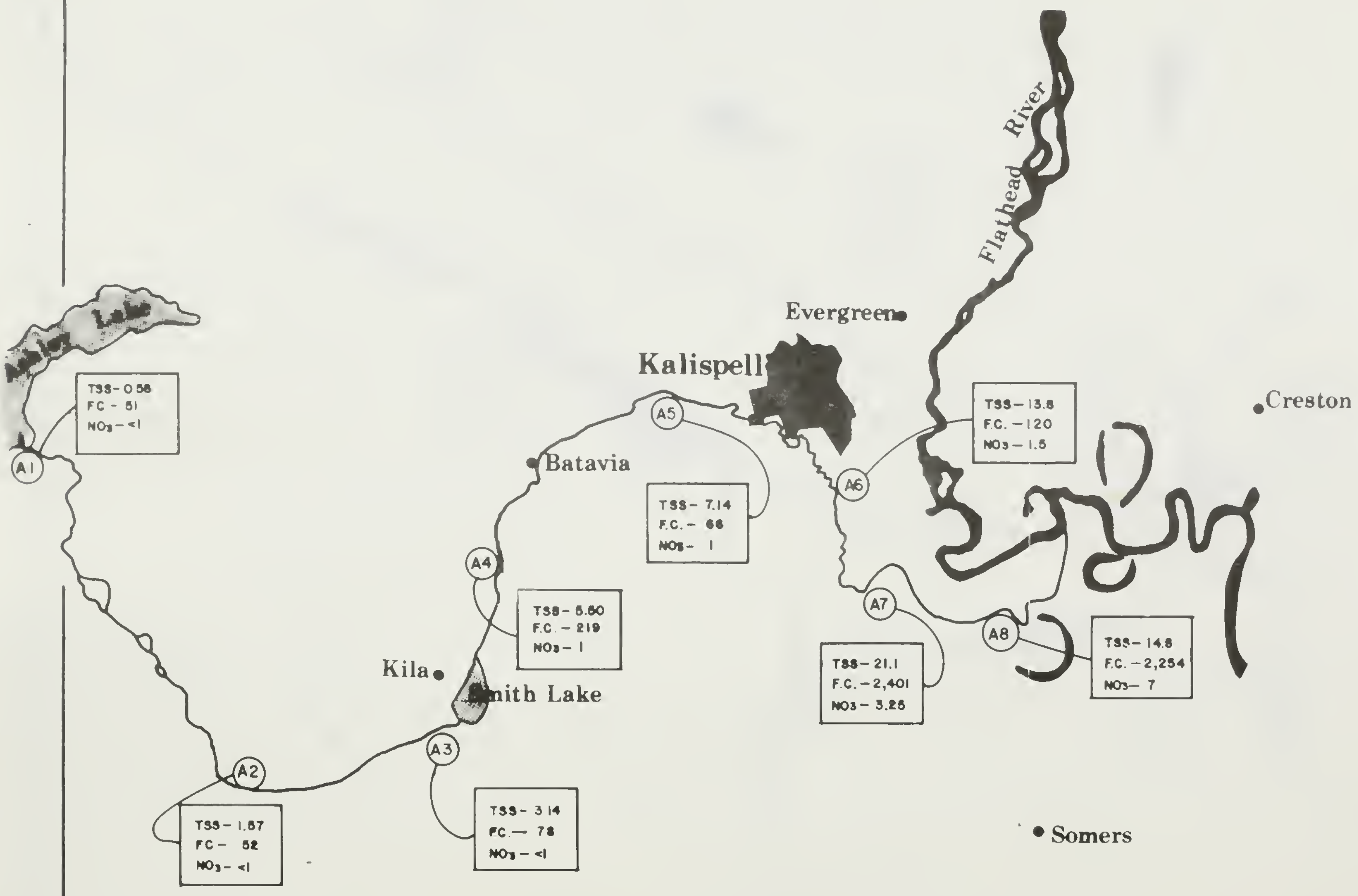
Nitrates in water can be from many sources, rainfall, municipal discharges and runoff, agricultural chemicals, septic tank leachate, livestock, and natural surface runoff. Among the United States waters supporting a good to excellent fishery population, 50 percent have less than 0.9 ppm nitrate while 95 percent have less than 4.2 ppm (McKee and Wolf, 1963). High or increased nitrate concentrations may, in the presence of adequate sunlight and other nutrients, stimulate agal blooms, and as a secondary impact can reduce the available dissolved oxygen in an aquatic habitat.

Fecal coliform are looked upon as an indicator of wastewater or mammalian fecal pollution. Wastewater treatment plants, livestock confinement areas and large instream concentrations of cattle can all be responsible for increased levels of coliform organisms.

UPPER FLATHEAD VALLEY

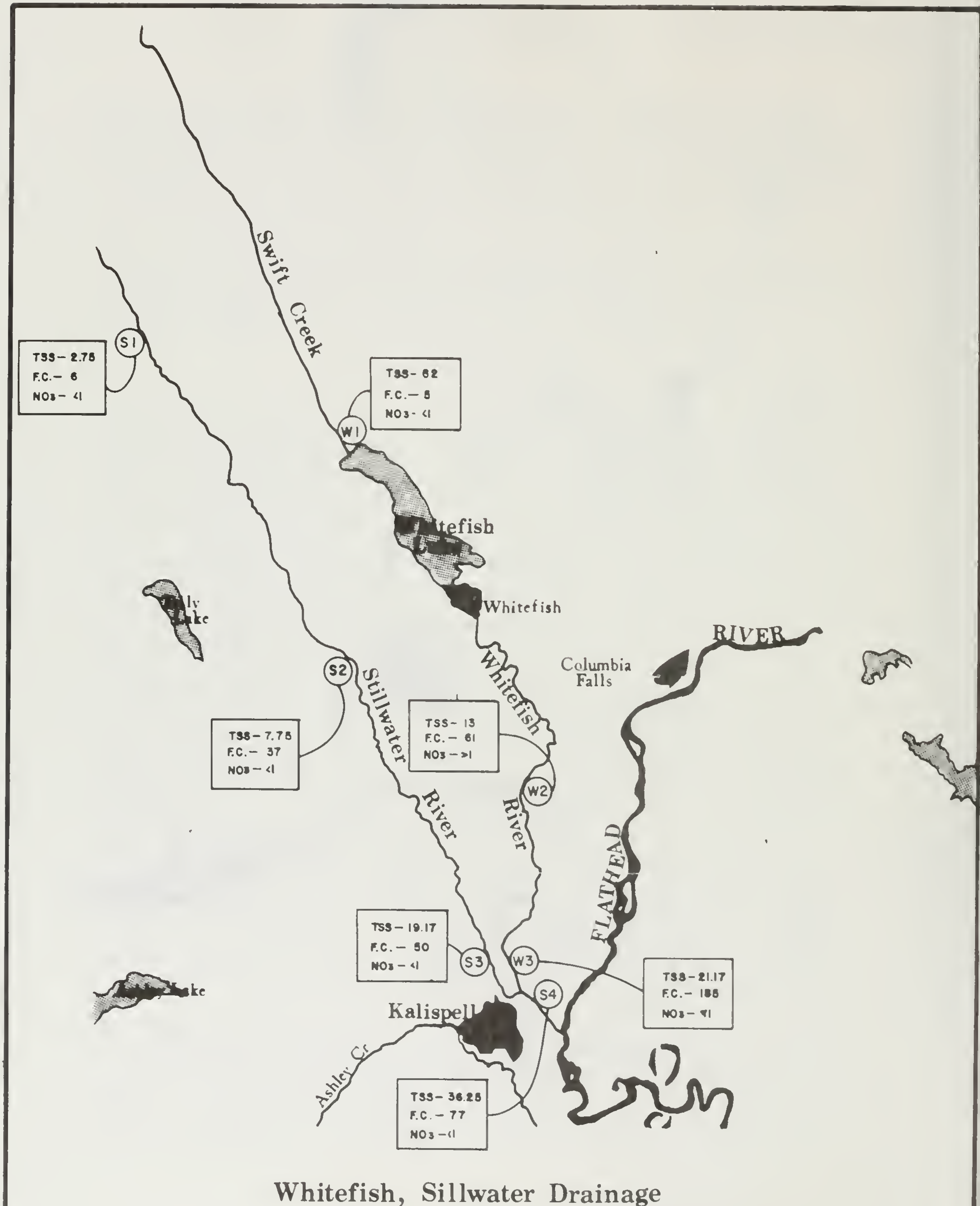
Ashley Creek presents a rather typical example of what is occuring in many streams in the study area (Figure 5-1). While the conditions observed in Ashley are more severe and dramatic than those seen in most other streams within the area, these conditions clearly illustrate the fact that as the human related activities along a stream segment increase, the concentration of pollutants also increase. The water discharged from Ashley Lake is of a very high quality except for the coliform concentration resulting from homes and cabins along its shores. By the time it flows into the Flathead River below Kalispell it has changed radically. While only 2 percent (Table 5-1) of the surrounding land is in irrigated agriculture, this along with cattle grazing along its banks, septic tank drainage, and the reservoir of material in Smith Lake play the major role in any degradation occuring prior to Kalispell. Following the rather dramatic impact of the City and the addition of effluent discharged from its wastewater treatment facility, Ashley Creek passes through an intensive agricultural area before reaching the Flathead River. Between its origin and confluence, Ashley Creek appears to undergo more degradation than any single stream evaluated during this study. The most significant areas of contributing impact are the City of Kalispell and the discharge from its wastewater treatment plant. Nitrate and Fecal coliform are the highest (average concentrations) of any stream segment in the upper drainage. Assuming an average daily flow of 38 cfs almost 14,000 lb of nitrate is discharged annually into the Flathead River by Ashley Creek.

The Whitefish and the Stillwater Drainages are very similar in geomorphic origins and associated uses. Figure 5-2 presents a comparative selective summary of the average water quality of these two rivers. The major influences that these drainages are exposed to are almost identical except for the wastewater discharge and urban runoff and drainage



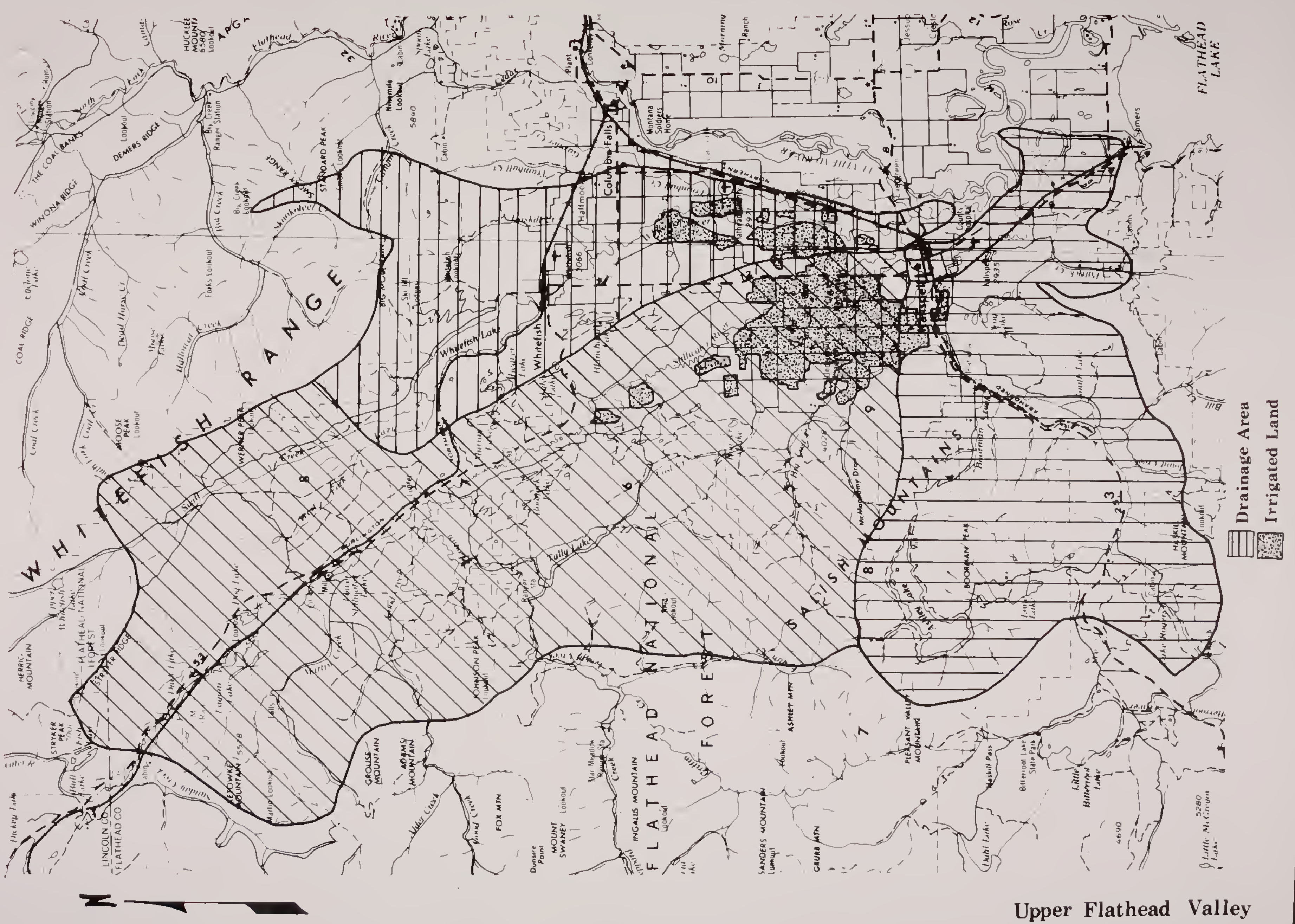
Ashley Creek Drainage

Figure 5-1



Whitefish, Sillwater Drainage

Figure. 5-2



Upper Flathead Valley

Figure 5-3

TABLE 5-1

SUMMARY OF IRRIGATION PRACTICES LOWER FLATHEAD VALLEY

	Total Drainage (D) mi^2	Irrigated* (I) mi^2)	Sprinkler Irrigated (S) mi^2)	I/D (%)	S/I (%)
Jocko Drainage	262	31	4**	12	13
Mission Post Drainage	194	89	11.75	46	13
Crow Creek Drainage	122	61	20	50	33
Stillwater Drainage	398	26	--	7	--
Whitefish Drainage	135	8.75	--	7	--
Ashley Drainage	205	3	--	2	--

*Flathead Irrigation Project

**Information available for Lake County only (18 mi^2 total irrigated)

All values are approximate and are expressed in square miles.

Sprinkler irrigation information was supplied by the Lake County SCS.

TABLE 5-1

SUMMARY OF IRRIGATION PRACTICES
LOWER FLATHEAD VALLEY

	Total Drainage (D) mi^2	Irrigated* (I) mi^2)	Sprinkler Irrigated (S) mi^2)	I/D (%)	S/I (%)
Jocko Drainage	262	31	4**	12	13
Mission Post Drainage	194	89	11.75	46	13
Crow Creek Drainage	122	61	20	50	33
Stillwater Drainage	398	26	--	7	--
Whitefish Drainage	135	8.75	--	7	--
Ashley Drainage	205	3	--	2	--

*Flathead Irrigation Project

**Information available for Lake County only (18 mi^2 total irrigated)

All values are approximate and are expressed in square miles.

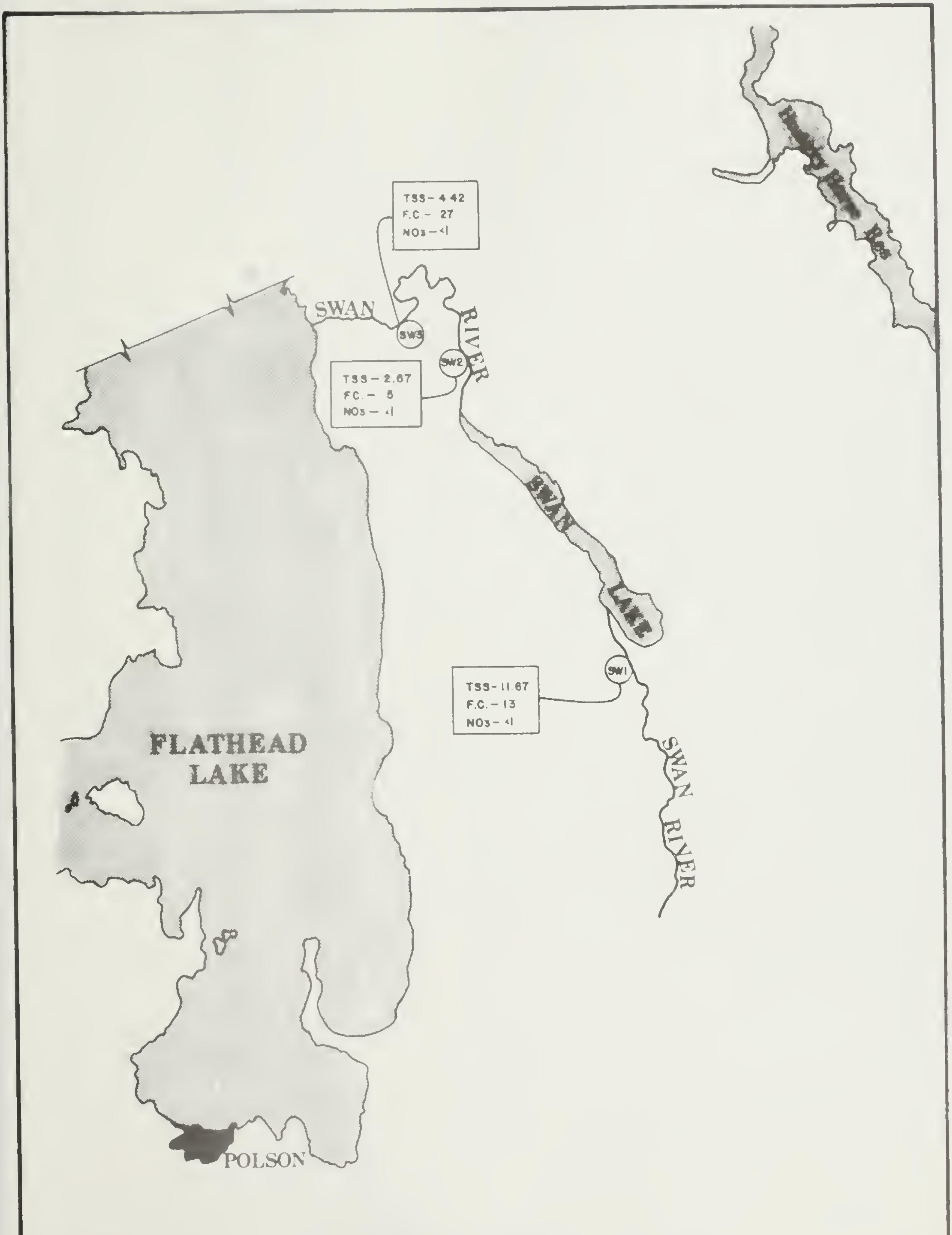
Sprinkler irrigation information was supplied by the Lake County SCS.

from the town of Whitefish. Irrigated agriculture accounts for approximately 7 percent (Table 5-1) of the land area in each drainage (Figure 5-3), and while some subdivision development is taking place north of Kalispell and in isolated pockets along the upper reaches of each river, the land within the drainage is relatively well managed. The only notable water quality problem on the Whitefish is Fecal coliform near its confluence with the Stillwater which is approaching the regulatory limit. Suspended solid concentrations increase in both rivers as they pass through the agricultural areas north of Kalispell. The combined flow from the Stillwater and Whitefish River contribute an annual sediment load of over 675 tons (390 from the Stillwater and 285 from the Whitefish) to the Flathead River. This equates to approximately 0.03 tons per irrigated acre each year. For the most part this degradation appears to be the result of natural stream bank cutting aggravated, quite likely, by irrigation as discussed in Section 4. Nitrates, as would be expected given the soils and irrigation practices in the area, were below the limits of detectability for the analytical technique utilized. This finding follows the conclusion made by researchers from the Western Agricultural Research Center at Corvallis, Montana, (Graham 1975) indicating that general stream pollution from agriculturally applied nitrates in the Upper Flathead Valley is quite improbable given the proliferation of sprinkler irrigation application methods and soils types.

The Swan River, as depicted in Figure 5-4 is of extremely high quality given the logging and recreational activity that already occurs in the upper drainage. Therefore, its water quality should be considered critical in terms of maintaining the existing high quality conditions. While the soils in the Swan are among the more stable in the study area, any major increase in construction, logging or building could have a significant impact in the drainage. It should be pointed out that while no problems are anticipated, the water supply for the town of Big Fork is taken untreated (except for chlorination) from the Swan River. Any marked increase in solids or turbidity as a result of increased development in the upper drainage could force the town of Big Fork to seek other sources of domestic water or provide additional treatment. While no immediate problems of this type are indicated by this study's data, the problem has occured in other similar watersheds where adequate planning measures were not taken.

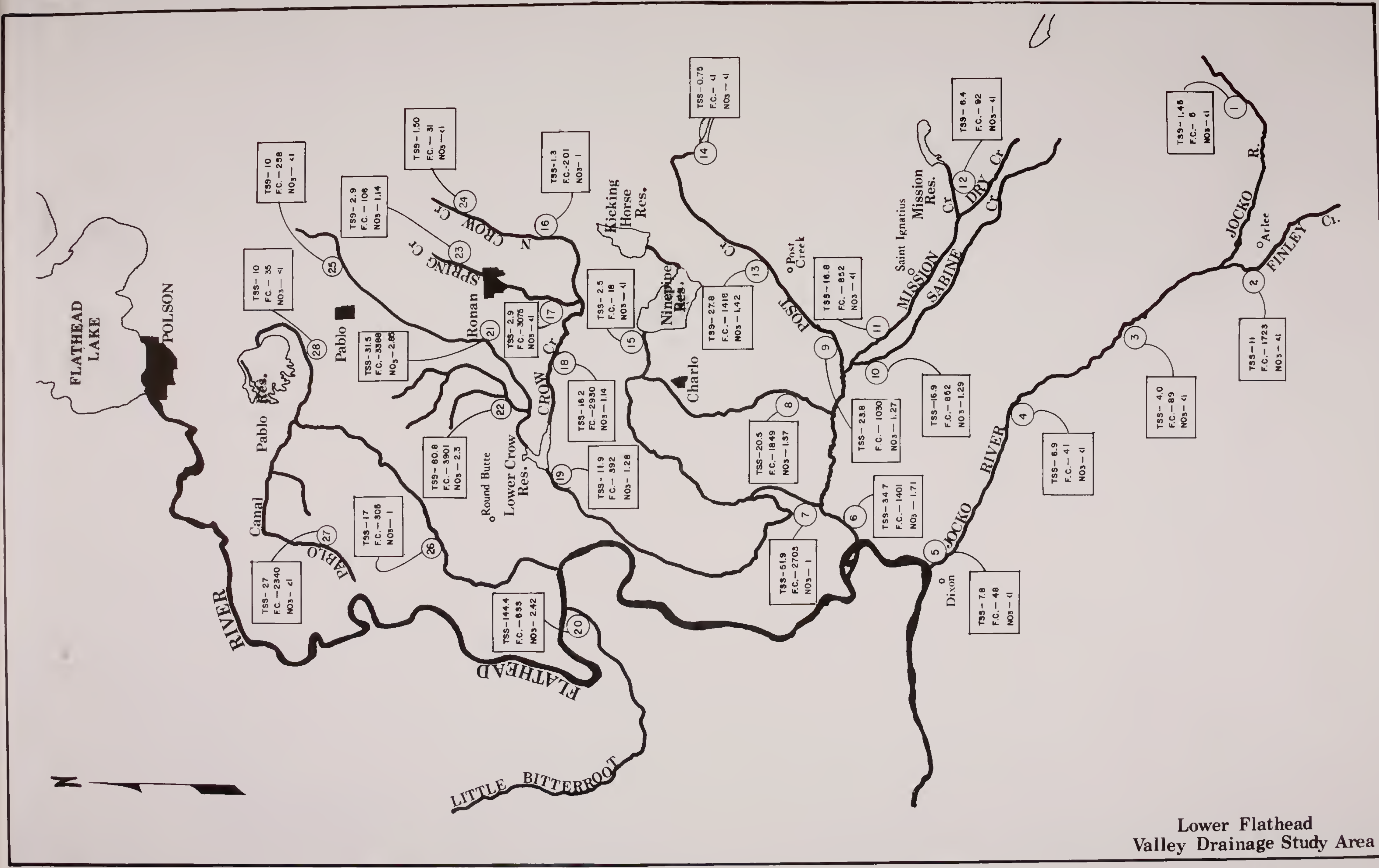
LOWER FLATHEAD VALLEY

Figure 5-5 presents a summary of water quality for the Lower



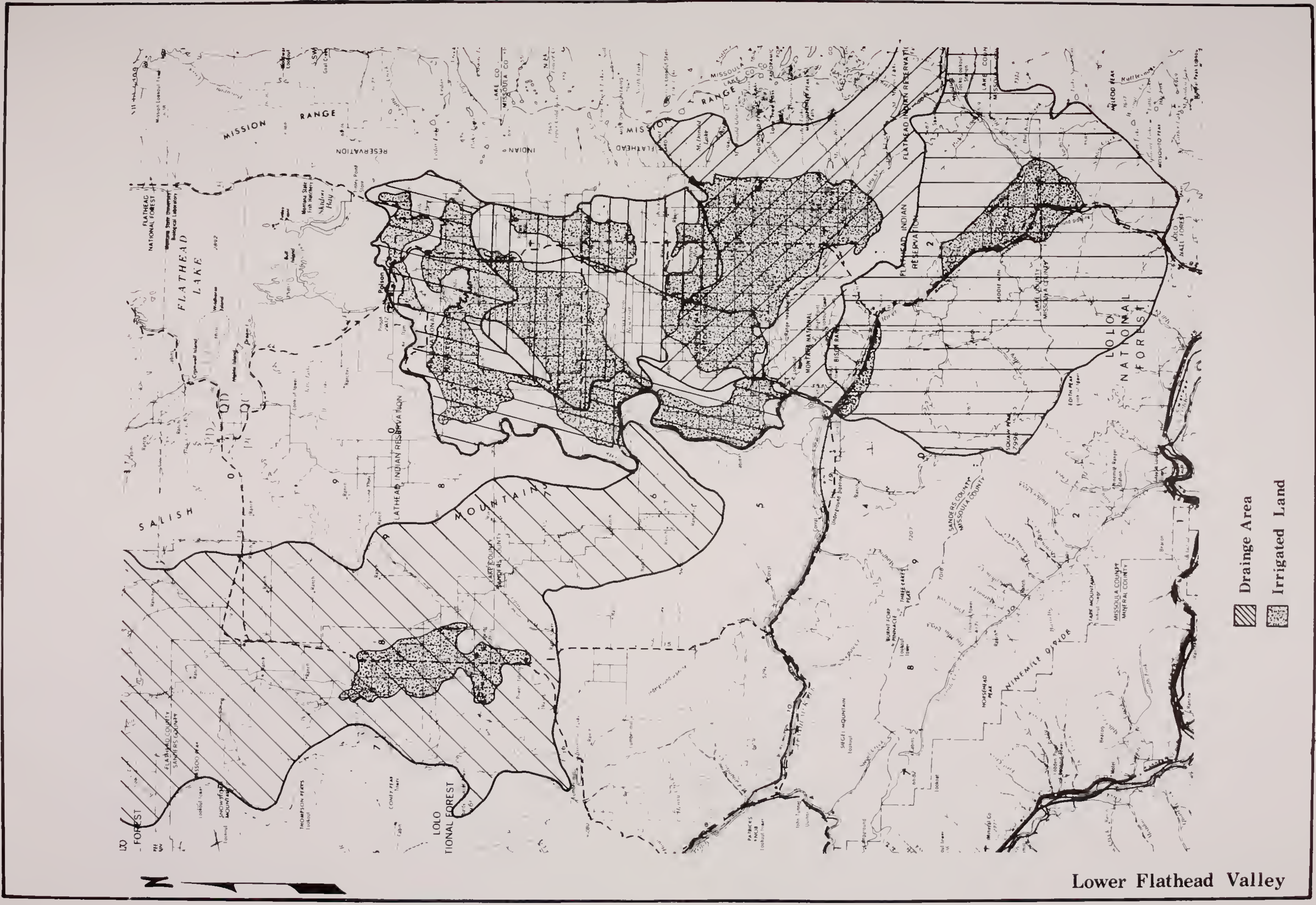
Swan River Drainage

Figure 5-4


FLATHEAD LAKE
POLSON
Pablo Res.
Pablo
Pablo Canal
PABLO
FLATHEAD RIVER
LITTLE BITTERROOT
Ronan
SPRING Cr
N CROW Cr
CROW Cr
Lower Crow Res.
Round Butte
Kicking Horse Res.
Ninepipe Res.
Charlo
POST Cr
Post Creek
Saint Ignatius
Mission Res.
MISSION Cr
DRY Cr
SABINE Cr
JOCKO R.
JOCKO RIVER
Arlee
FINLEY Cr.
Dixon
N
1 TSS-1.46 F.C.-8 NO3-<1
2 TSS-11 F.C.-1723 NO3-<1
3 TSS-4.0 F.C.-89 NO3-<1
4 TSS-6.9 F.C.-41 NO3-<1
5 TSS-7.8 F.C.-48 NO3-<1
6 TSS-34.7 F.C.-1401 NO3-1.71
7 TSS-61.9 F.C.-2703 NO3-1
8 TSS-20.5 F.C.-1849 NO3-1.57
9 TSS-23.8 F.C.-1030 NO3-1.27
10 TSS-16.9 F.C.-852 NO3-1.29
11 TSS-16.8 F.C.-852 NO3-<1
12 TSS-6.4 F.C.-92 NO3-<1
13 TSS-27.8 F.C.-1418 NO3-1.42
14 TSS-0.75 F.C.-<1 NO3-<1
15 TSS-2.5 F.C.-18 NO3-<1
16 TSS-1.3 F.C.-201 NO3-1
17 TSS-2.9 F.C.-3075 NO3-<1
18 TSS-16.2 F.C.-2930 NO3-1.14
19 TSS-11.9 F.C.-392 NO3-1.28
20 TSS-144.4 F.C.-633 NO3-2.42
21 TSS-31.5 F.C.-3388 NO3-2.85
22 TSS-80.8 F.C.-3901 NO3-2.3
23 TSS-2.9 F.C.-106 NO3-1.14
24 TSS-1.50 F.C.-31 NO3-<1
25 TSS-10 F.C.-238 NO3-<1
26 TSS-17 F.C.-306 NO3-1
27 TSS-27 F.C.-2340 NO3-<1
28 TSS-10 F.C.-35 NO3-<1

Lower Flathead Valley Drainage Study Area

Figure 5-5



Lower Flathead Valley

Figure 5-6

Flathead Valley. As can be seen by comparing the concentration of measured parameters and total area irrigated from Table 5-1 and as the amount of irrigated land increases within a particular subdrainage, its water quality generally decreases. This inverse relation holds true throughout the three major subdrainages considered (Jocko, Crow and Mission).

The quality of water within the subdrainages of the Lower Flathead Valley, is highest as streams leave their mountain source but is degraded rapidly on the relatively short journey to the Flathead River. While economic activities in the area are confined primarily to agriculture, a number of other documented and potential pollutant sources are found in the area. As seen in Figure 5-6, a large portion of the drainage is under irrigated agriculture. In addition, a number of point and non-point sources of pollution from towns, residential developments, and light industrial/commercial activity are responsible for the decreased in-stream water quality observed throughout the area.

The Jocko River has the highest overall quality water of any stream system in the Lower Flathead Valley which discharges directly into the Flathead River. As shown in Table 5-1, the Jocko River also has the smallest amount of total drainage area in irrigation and the highest percentage in sprinkler irrigation. While the Jocko undoubtedly is effected by towns, commercial fish ponds and developments, it maintains a relatively constant degree of water quality throughout its course. One significant problem, which is not reflected in the monitoring data, is irrigation withdrawals from the Jocko that can dewater sections of the river during the irrigation season. The negative effect of dewatering upon the fishery resources of the system was attested to by resource agency personnel as well as residents in the area. Migratory as well as endemic species are effectively blocked from utilizing the entire drainage by agricultural diversions. Except for the high Fecal coliform concentration and seasonal sediment problems from Finley Creek, the drainage on the average maintains the specific water quality criteria assigned to it by the State of Montana.

The Mission/Post drainage is extremely complex, carrying not only the flow from Mission, Post and Sabine Creeks and their tributaries, but a great deal of irrigation return flow from the Crow Creek Drainage. As the diagram in Figure 5-5 indicates, water quality is degraded badly between the headwaters of the system and its confluence near Moiese. Over 50 percent of the drainage is under irrigation of which only 13 percent of this is currently in sprinkler irrigation.

Thus a large portion of the region is irrigated by surface flooding which unless very carefully controlled results in excess water application and subsequent surface runoff. This excess either drains naturally back to the main drainage system, or is picked up by irrigation return canals and discharges into the major waterways. In many cases this is aggravated by poorly designed and inefficient delivery systems, that spill or lose water to the return drains. In addition, feed lots or confined livestock operations located on or within several of the tributary drainages, discharges from the wastewater treatment lagoons at Charlo and St. Ignatius, limited urban runoff and discharges from commercial fish hatcheries near Post Creek all combine in reducing water quality in the Mission/Post system, and degrading the associated aquatic environment.

The Crow Creek Drainage, like the Mission/Post, is hydraulically complex with a great deal of irrigation. Over 40 percent of the land area is under irrigation of which only 20 percent is applied by sprinklers. The town of Ronan and Pablo both add to the pollution load carried by the system along with the discharges from the dairy at Ronan. (Note: The dairy waste problem was corrected during the study.) As presented in Figure 5-5 the water quality conditions in the Crow Creek Drainage are similar to those in the Mission/Post Drainage. Lower Crow Reservoir acts as a settling basin to remove sediments and facilitate bacterial die off. Little of the water leaving lower Crow is returned to the Flathead River. Most of the flow is diverted out of the natural channel and utilized for irrigation in the area northwest of Charlo. The runoff from this area will eventually drain into the lower end of Mission Creek.

The stations maintained on the streams and canals leaving Pablo Reservoir also indicated the impacts of irrigation and return flow. In general, the further from the source the stream is sampled, the poorer the water quality in areas where surface irrigation is predominate and cattle are pastured or maintained in or around the drainage.

Only one sample station was established on the Little Bitterroot River. The Little Bitterroot, draining into the Flathead River at Sloan Bridge, had the highest concentration of suspended material of all stations sampled. Since no water quality data for the upper portion of the river was available, it can only be assumed from the known soil characteristics in the drainage that runoff is quite high and erosive. This phenomenon would account for the high sediment load carried by the Little Bitterroot.

Table 5-2 presents the annual sediment loading on the three main Lower Flathead Valley tributary subdrainages to the Flathead River considered in this study. Sediment was measured in terms of suspended solid only; bed load sediment and other sources were not evaluated.

TABLE 5-2

SEDIMENT LOADING LOWER FLATHEAD VALLEY

	Suspended Sediment (tons per year)
Jocko River	1770
Mission/Post/Crow Creeks	5658
Pablo "A" Canal	1753

No flow information was available for the Little Bitterroot River. It was therefore impossible to calculate annual loading, but due to the high sediment (i.e., solids) concentrations documented during this study, a significant amount of solids entering the Lower Flathead River must be generated within the Little Bitterroot River.

The calculated average annual suspended sediment (solids) loading, based entirely on irrigated acreage ranges between 0.08 - 0.09 ton per year, over twice that observed in the Upper Flathead drainage. This figure will require further refinement because it fails to include acreages outside the FD 208 Study Area that drain into tributary drainages that were monitored.

A number of additional factors and pollutant sources which can effect the quality of the aquatic environment were identified during the course of this study, but because of time and budgetary constraints could not be pursued in detail. While the potential adverse impacts of things such as the run off of pesticides and herbicides, the use of algicides in irrigation canals and disruptive in-stream hydrologic modification in the study area are known, they are often difficult to document given the low concentrations in which they appear in the environment, and clandestine application or operation. These problems will need to be addressed in terms of general areawide control measures by the final FD 208 Plan, but futher study is needed to accurately assess both their extent and impact in the region.

This report has summarized the study of individual drainages, stream segments, and waterways identified by the FD 208 staff as either of critical importance or lacking a concise baseline data base. It was not designed nor should it be interpreted as a comprehensive analysis of aquatic habitat of the entire FD 208 Study Area, but as a collection and tabulation of data relating to many of the streams impacted by human activity. It is expected that further interpretations will be made with this data, and that this report will serve as a framework to which additional information can be added in order to complete a comprehensive evaluation of the region's water quality.

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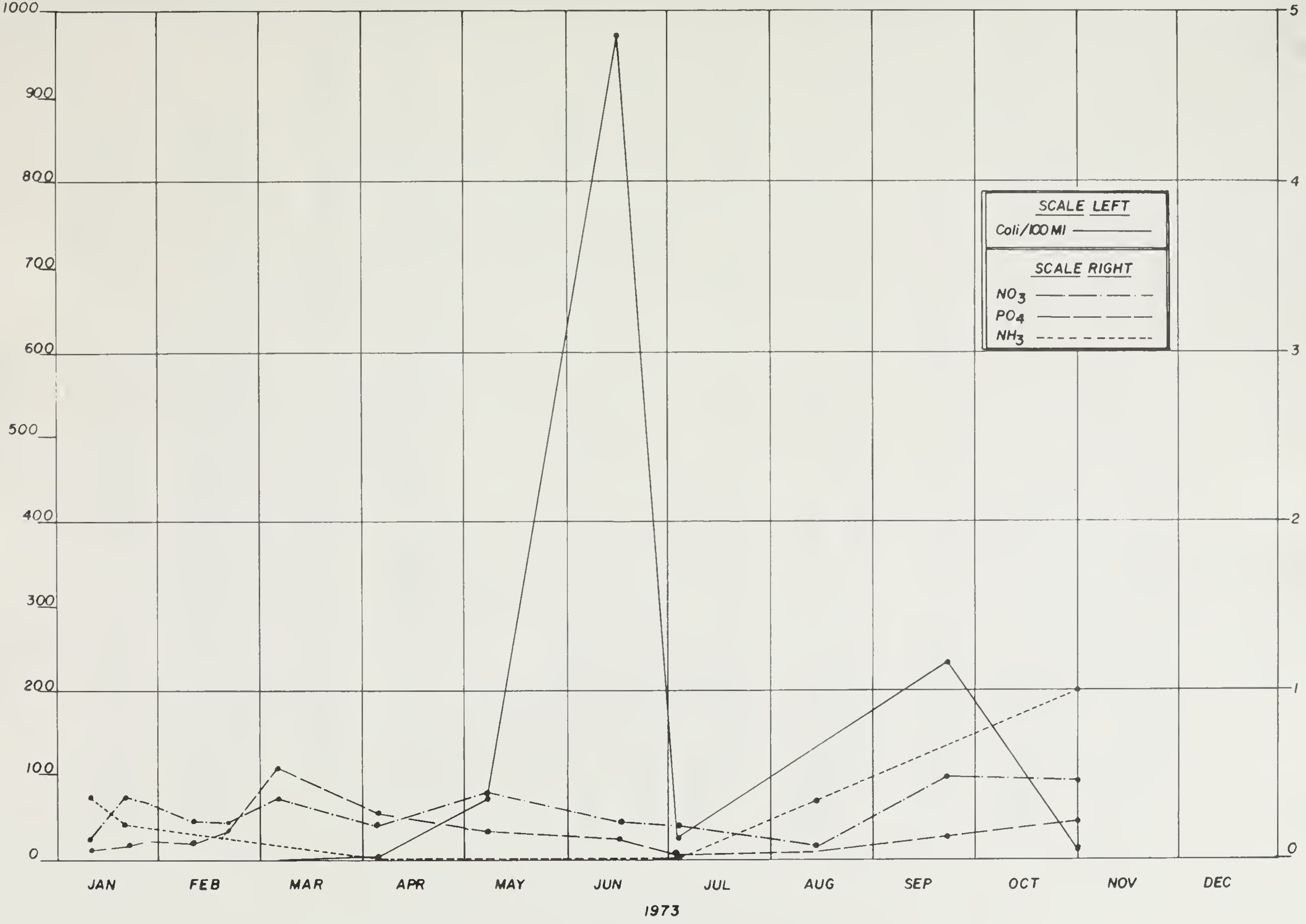
KWQB-24 ASHLEY CR. NR. KALISPELL (28N 22W BAC)
(6.3 Mi. W.)



Appendix A

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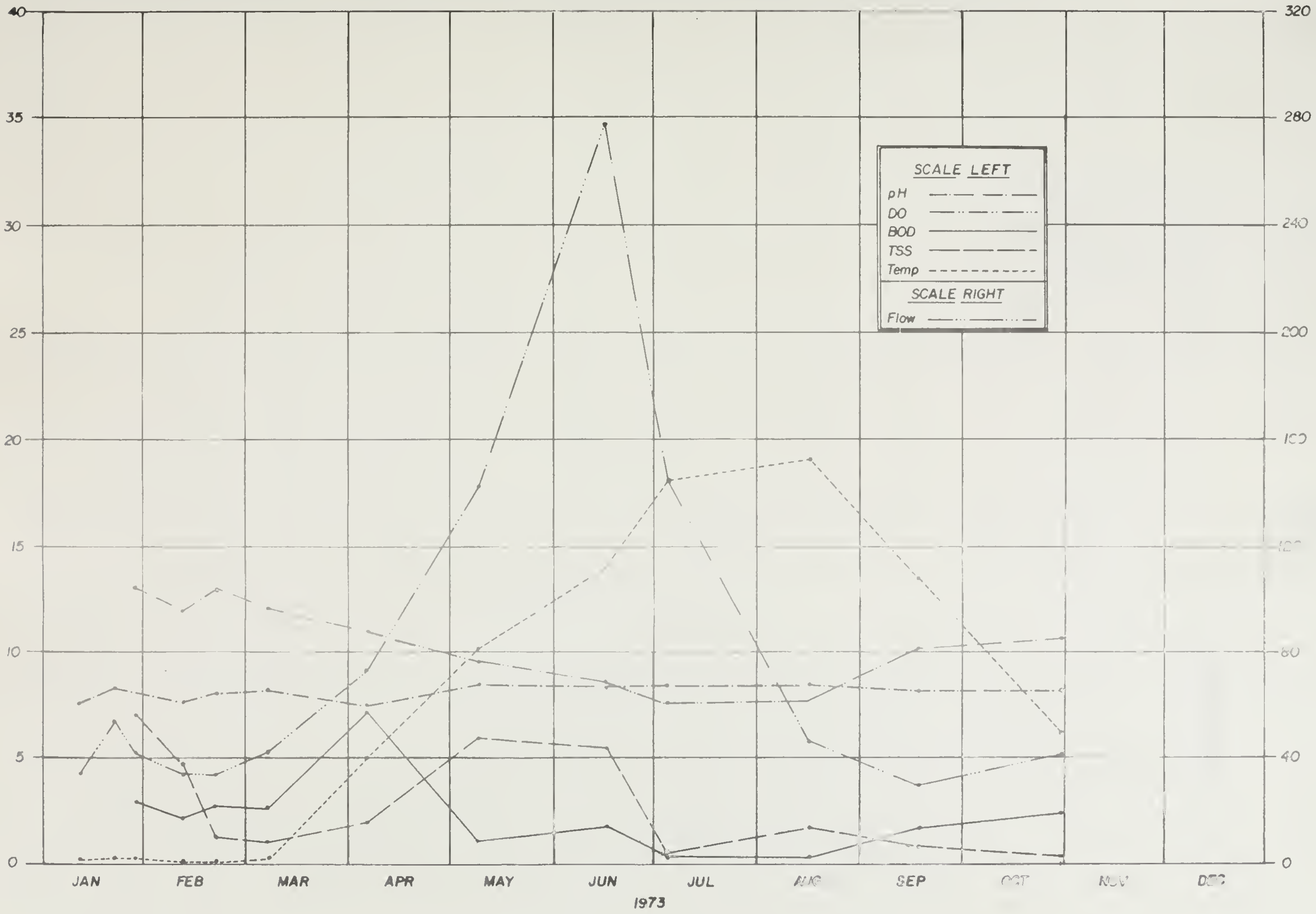

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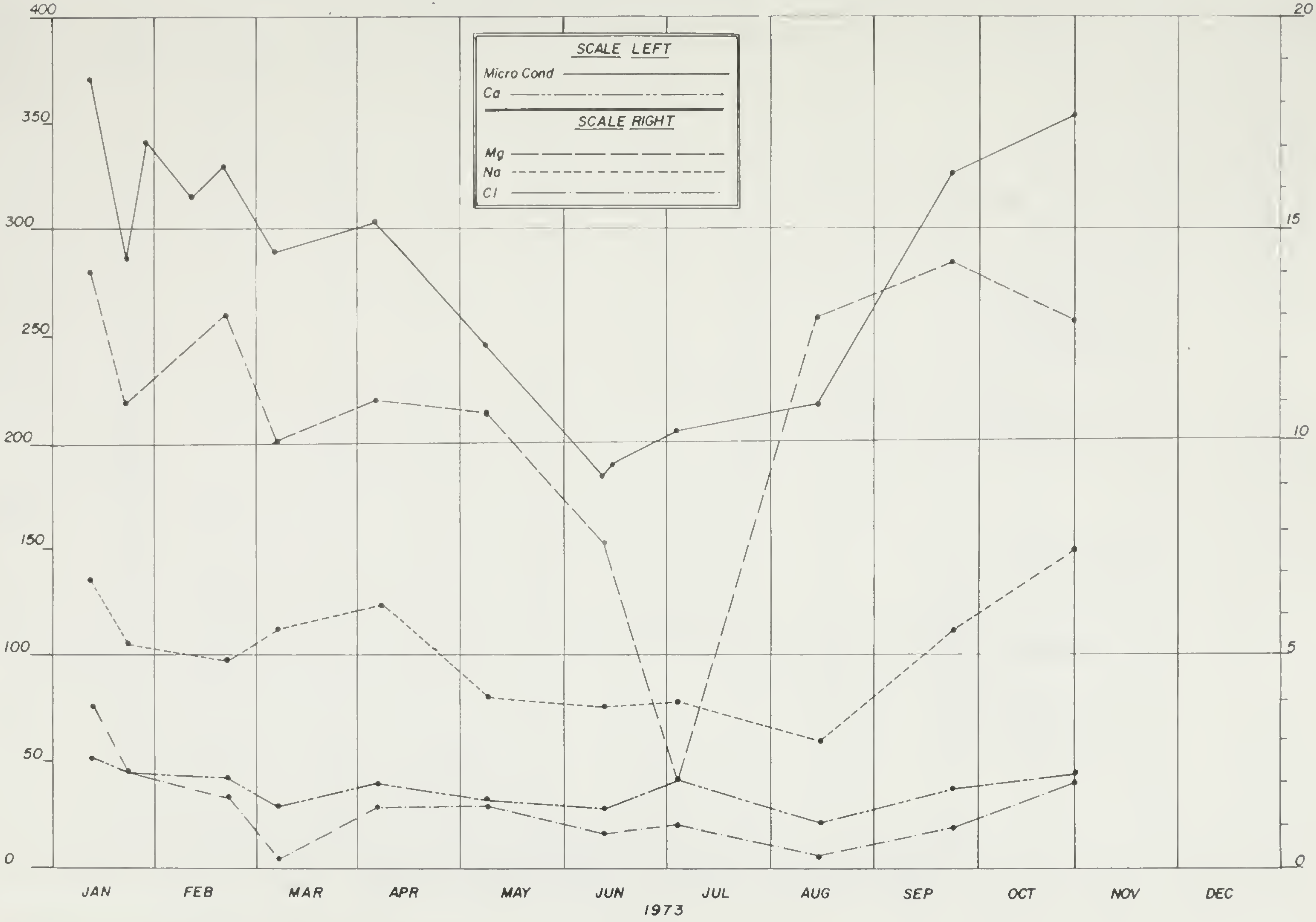

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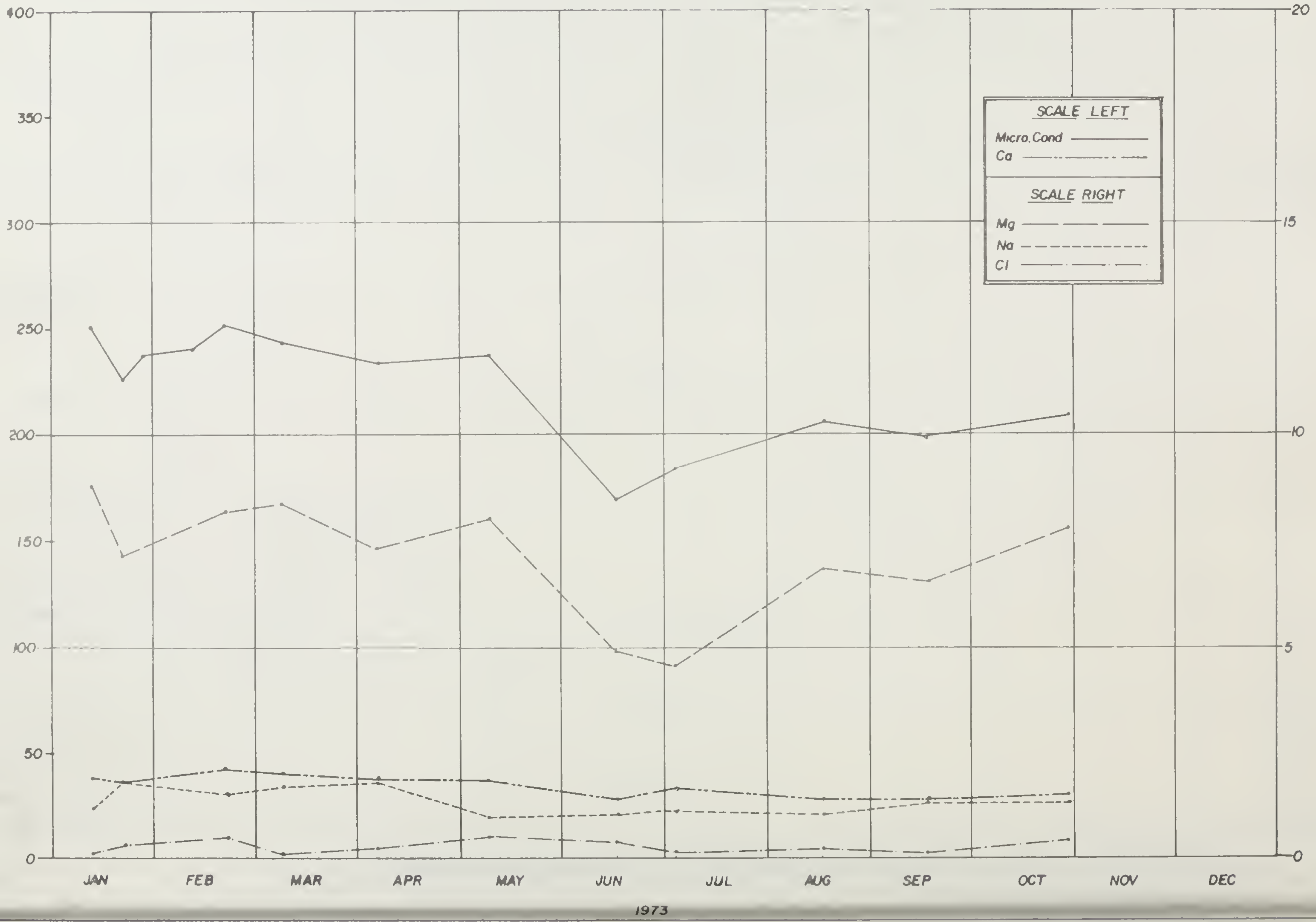

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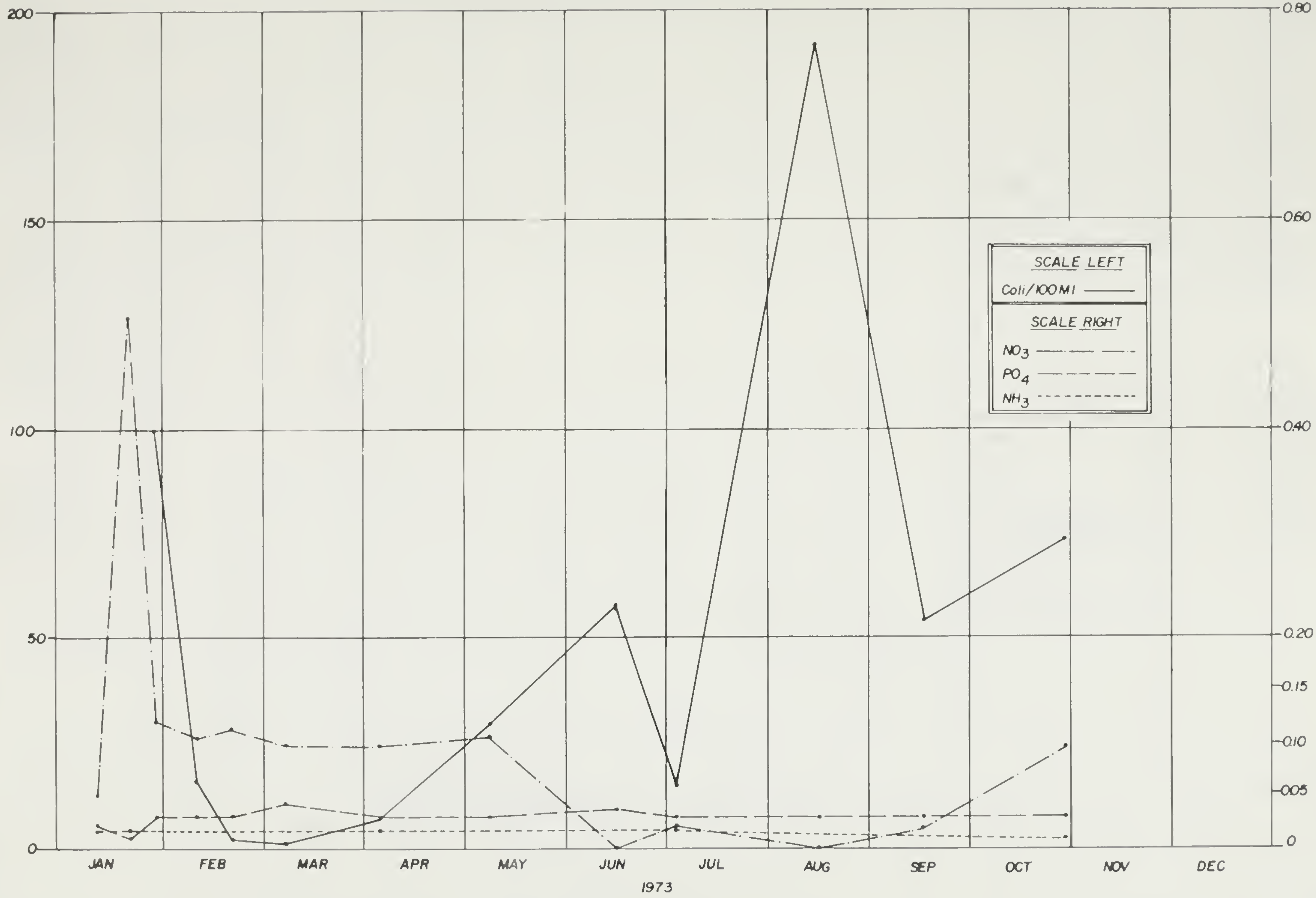

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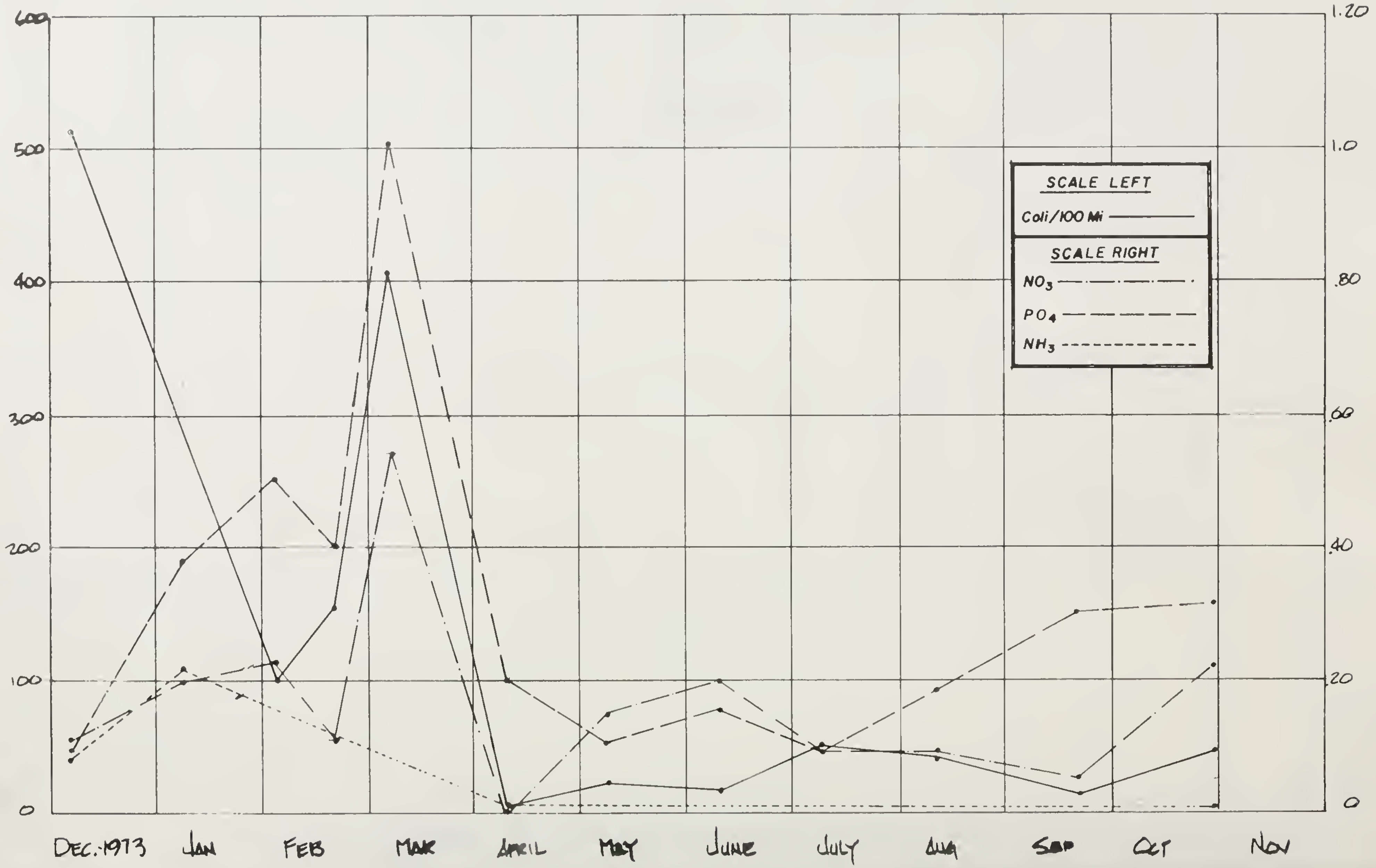

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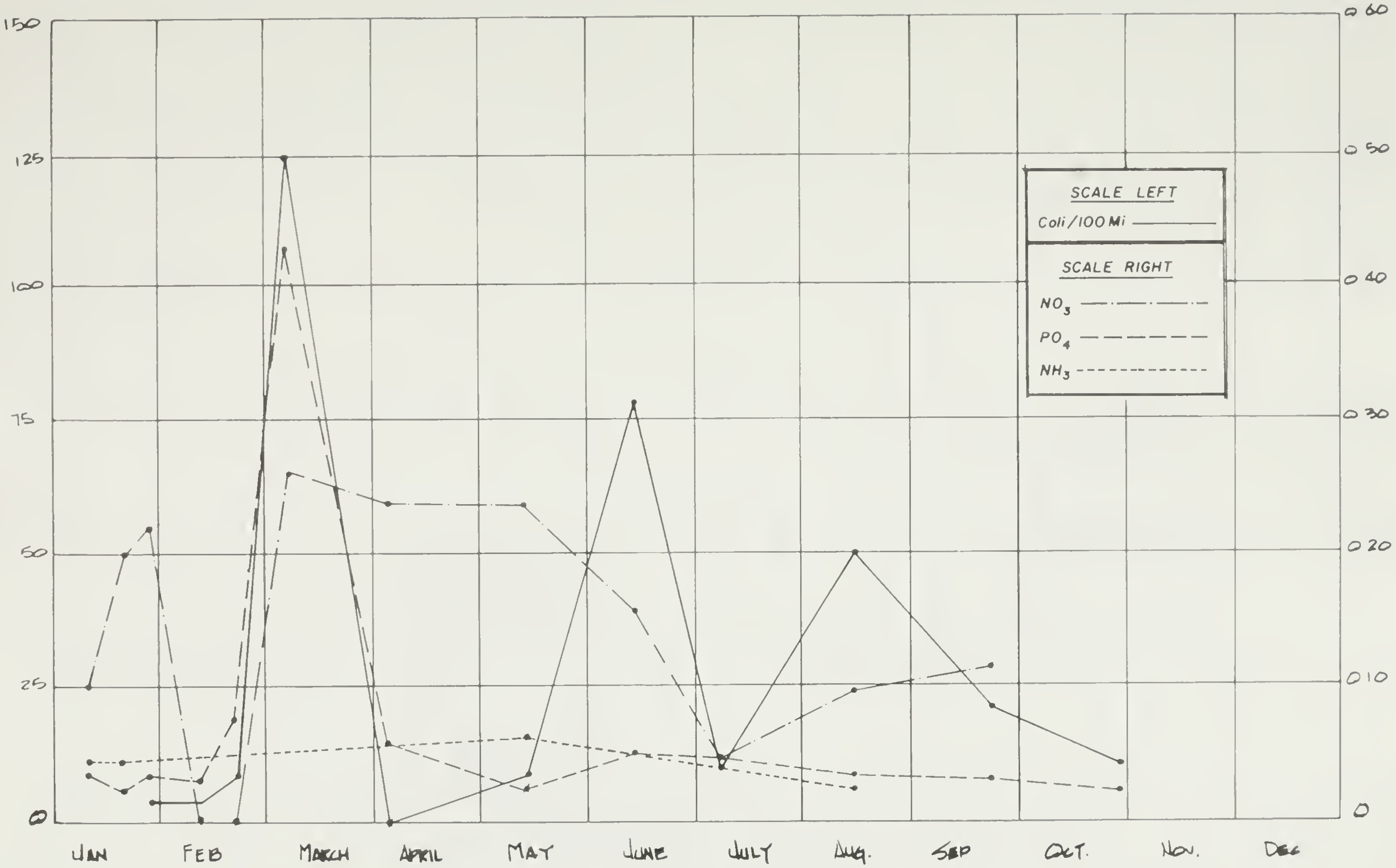

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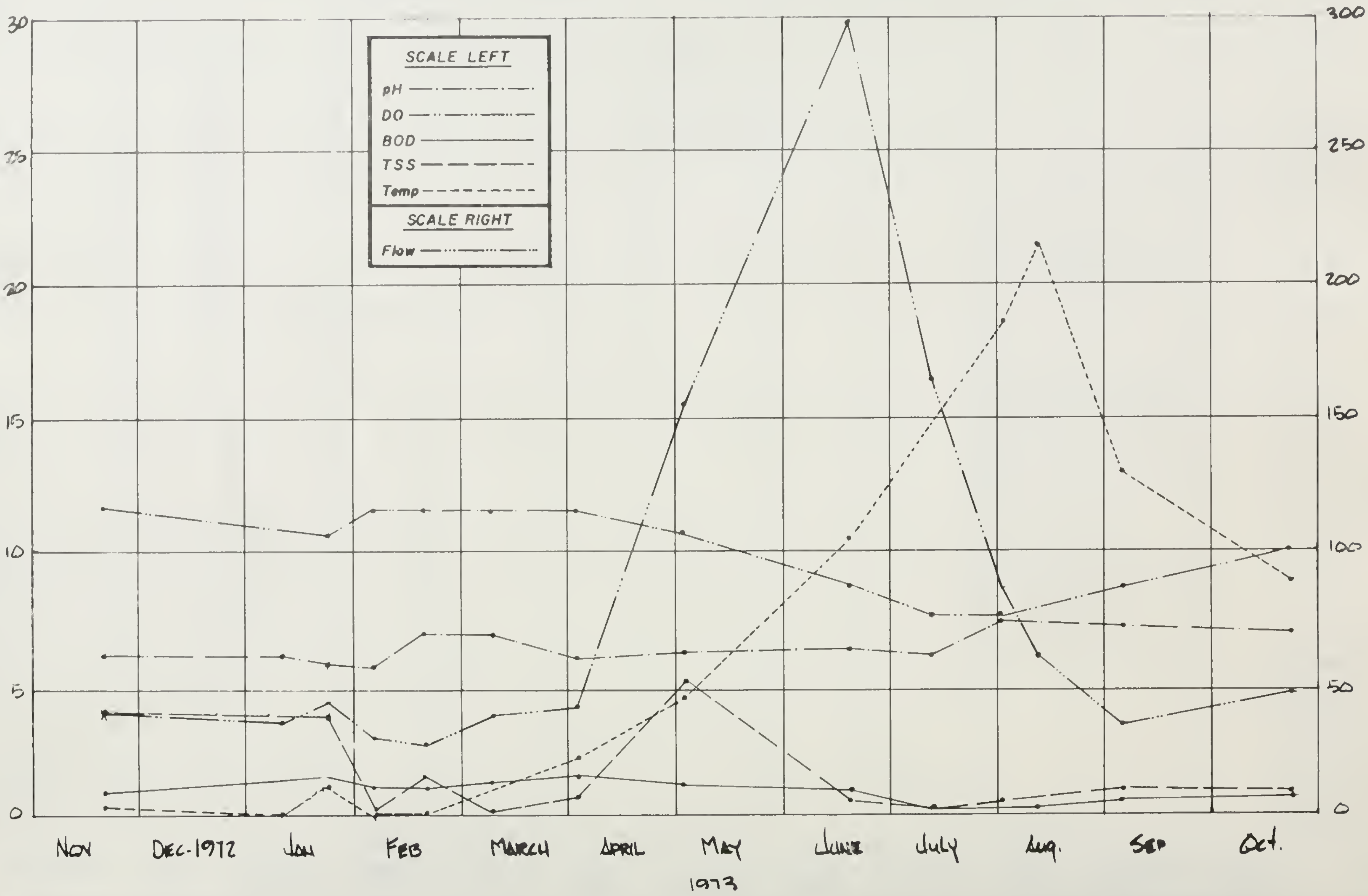

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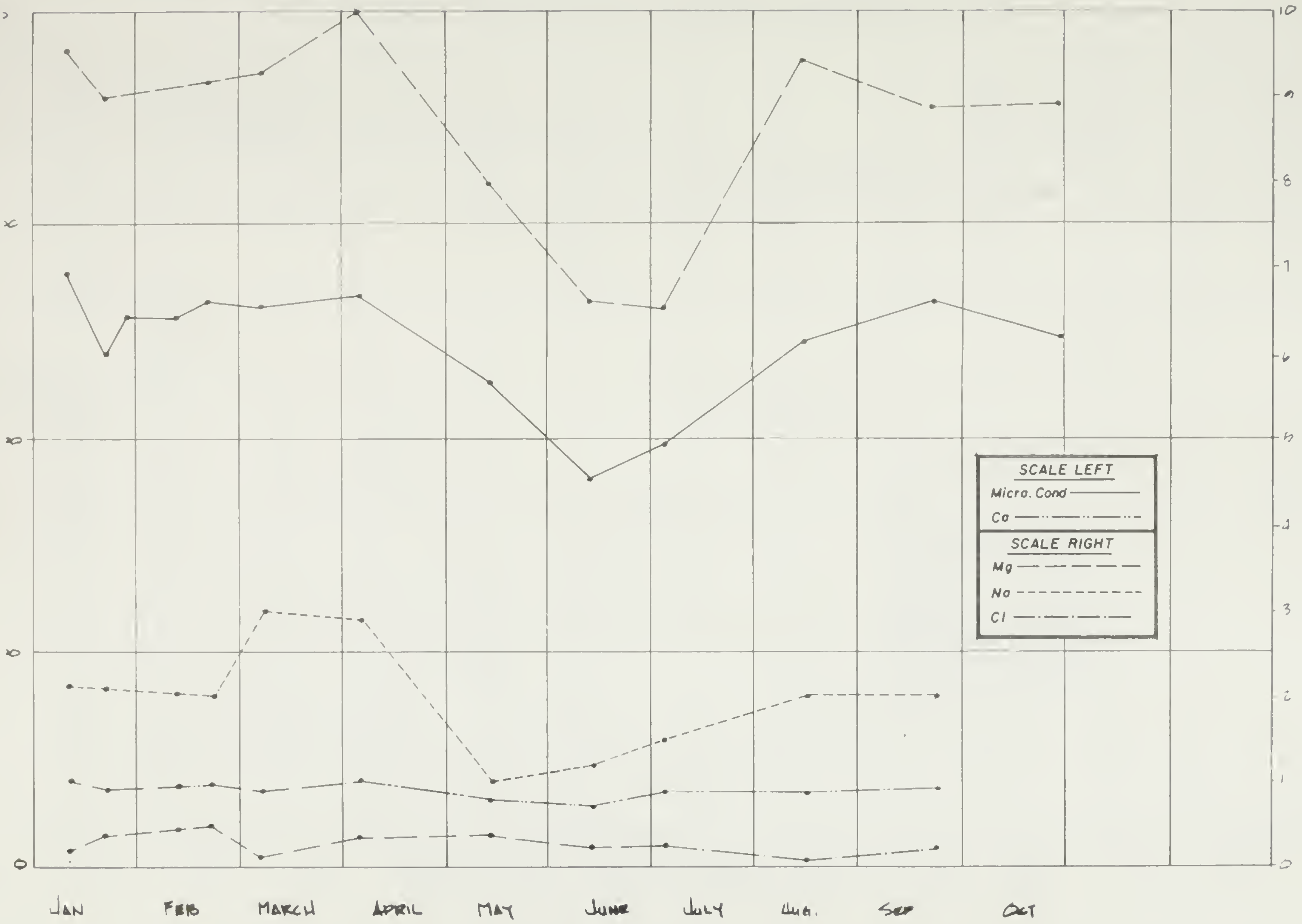

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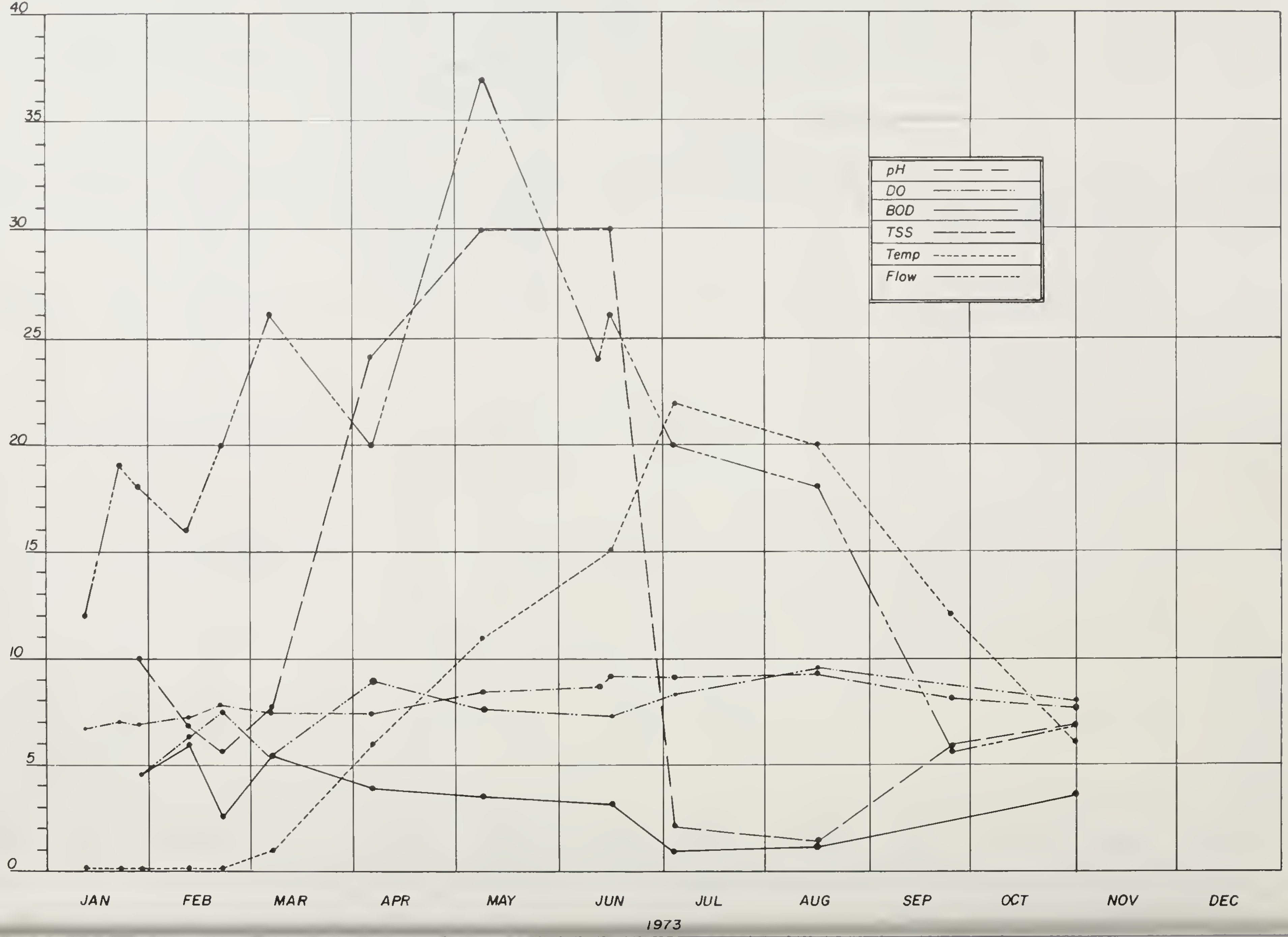

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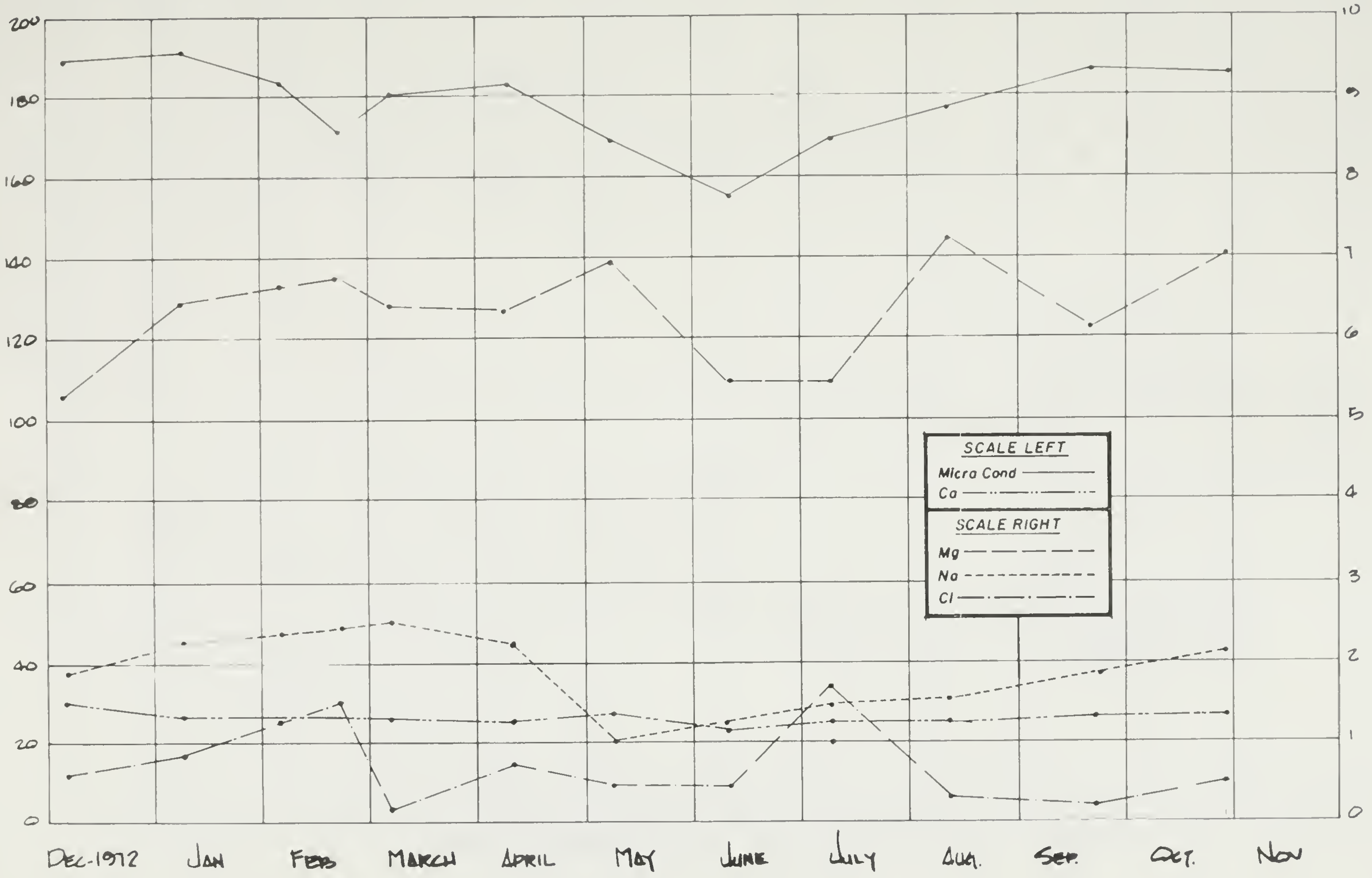

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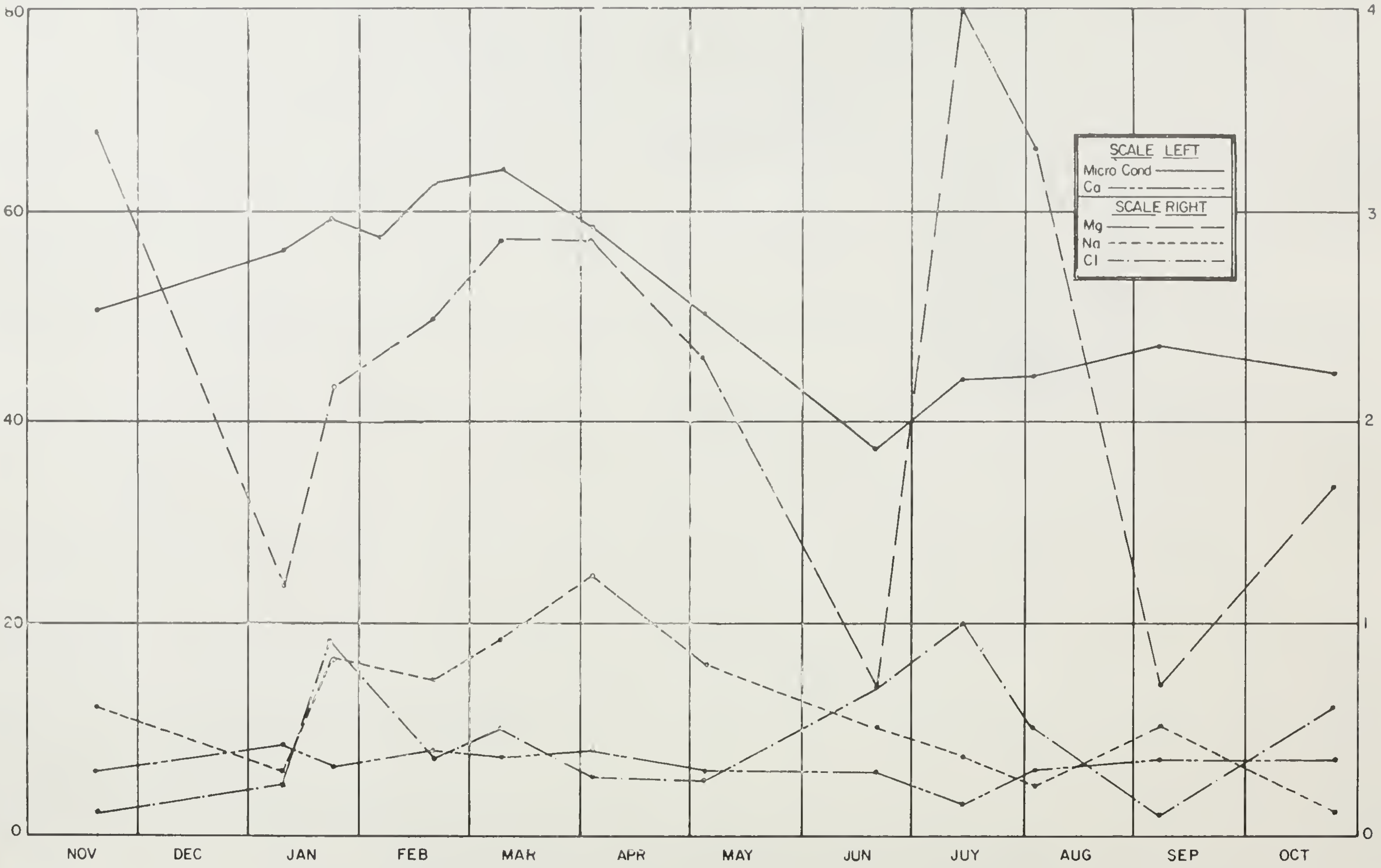

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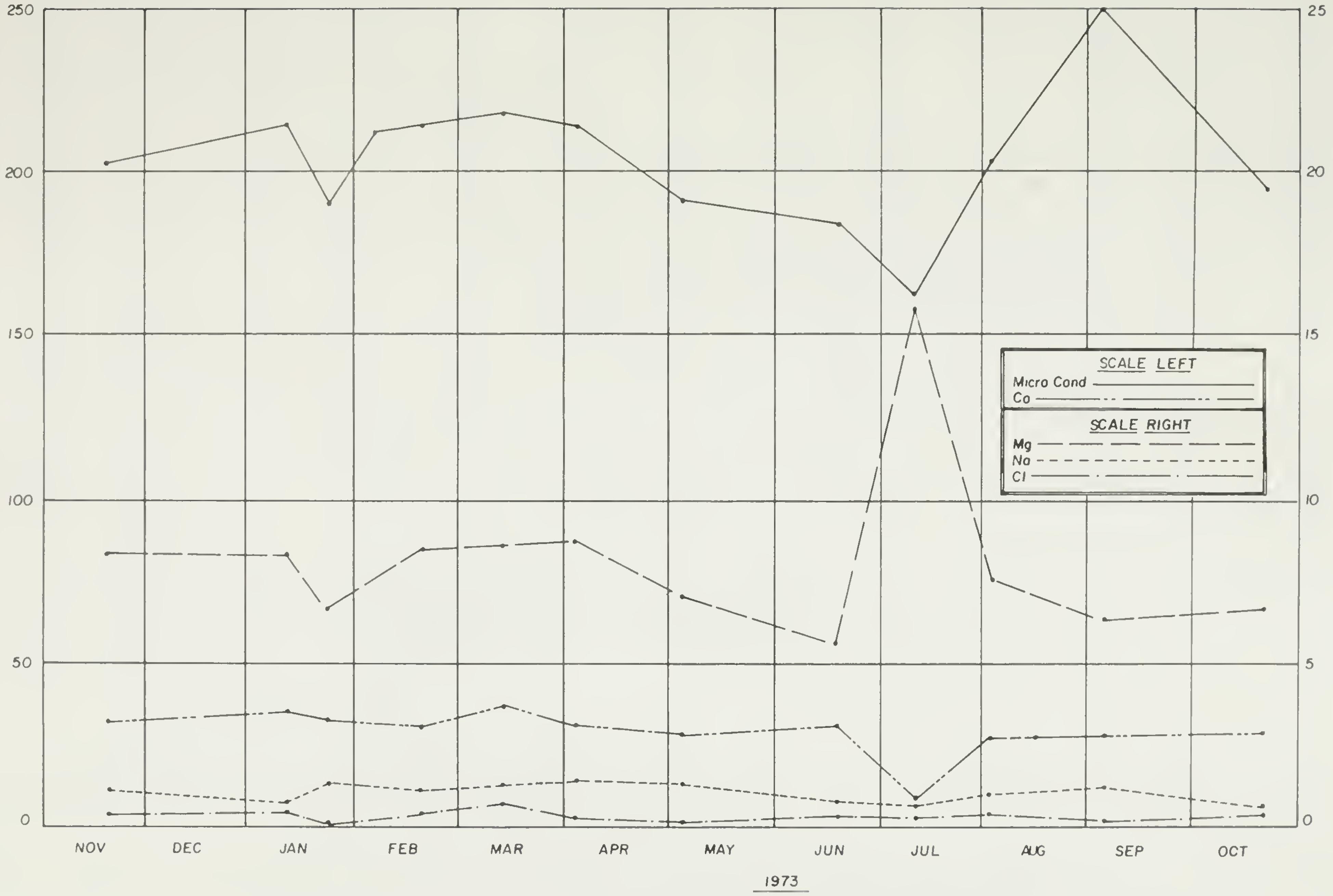

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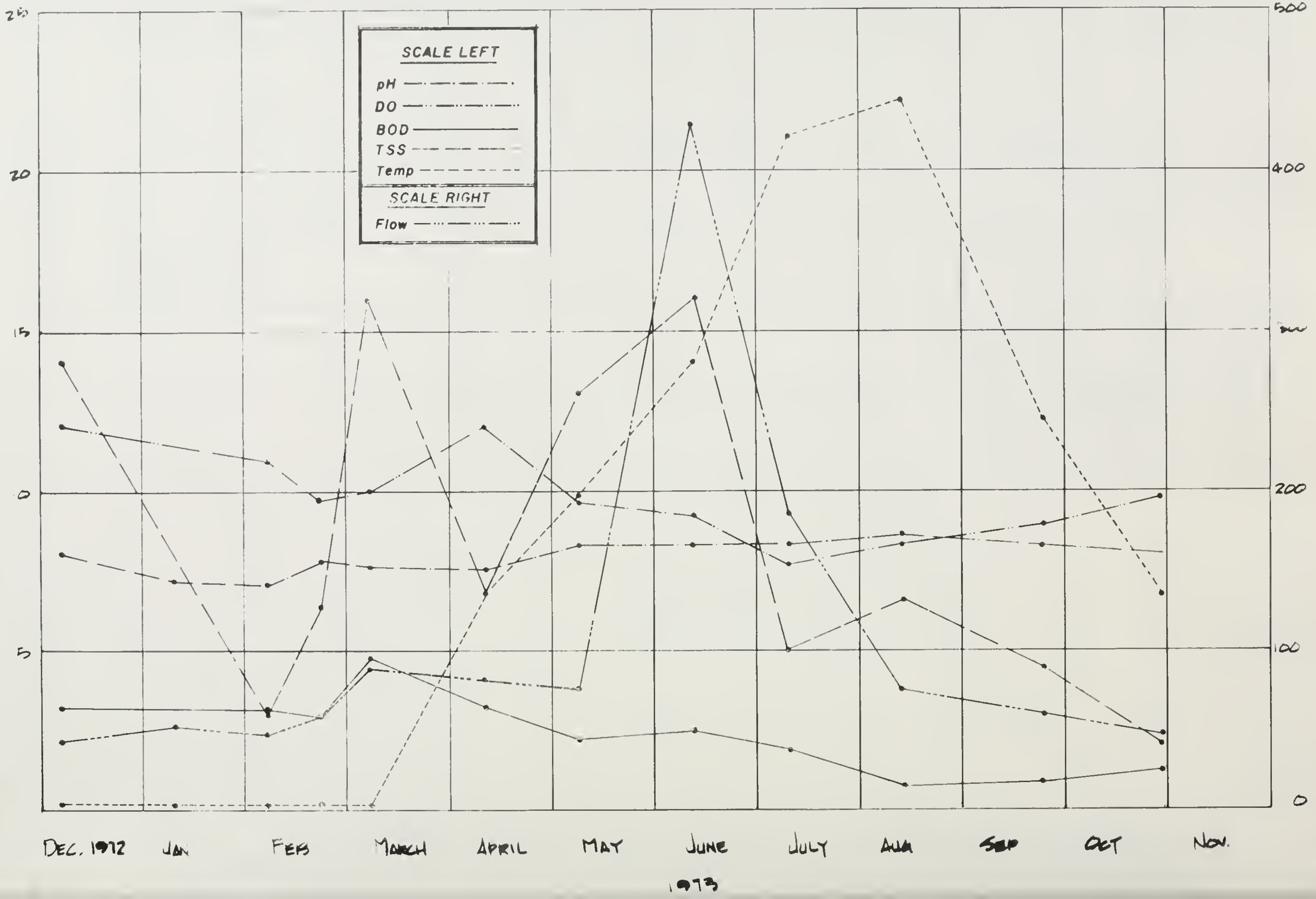

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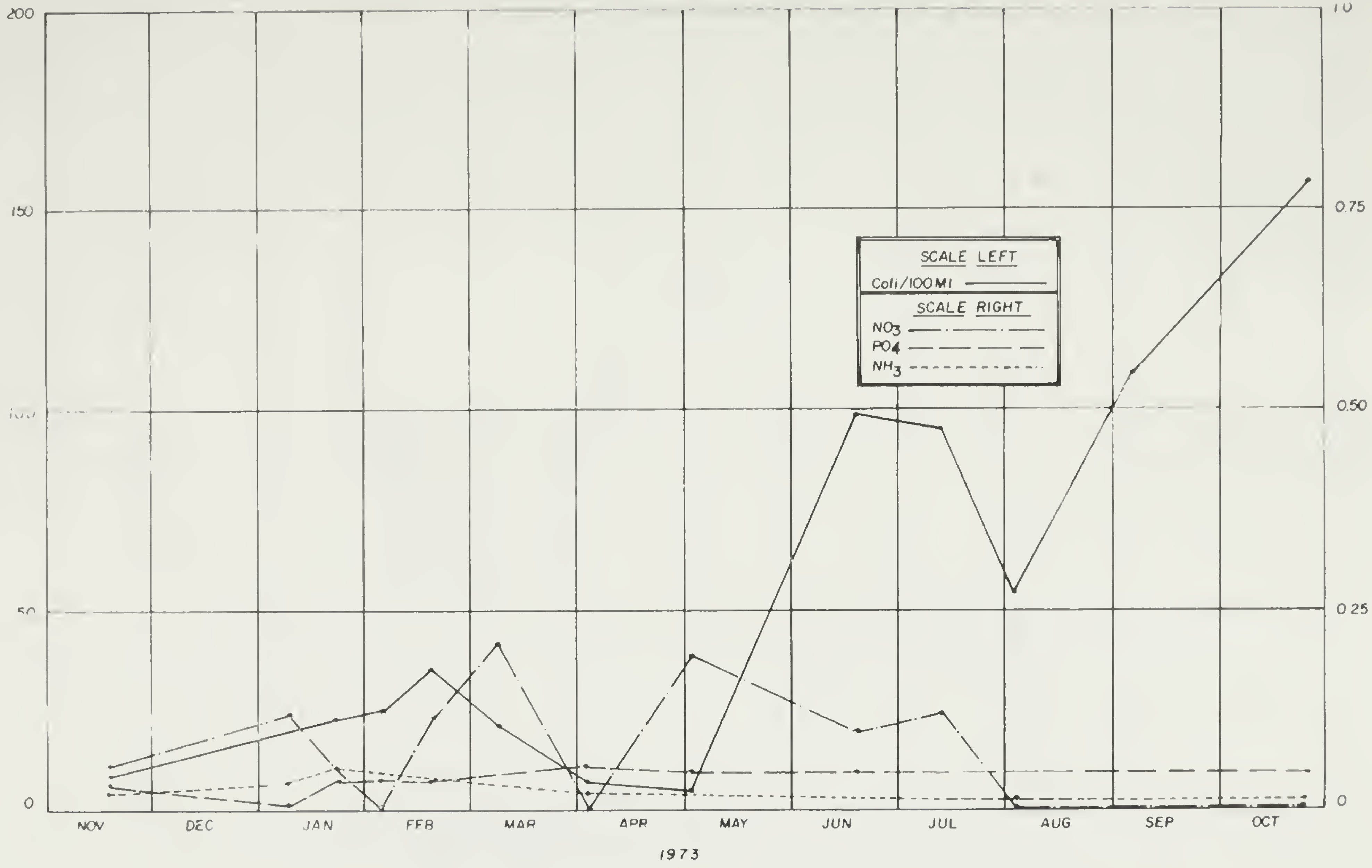

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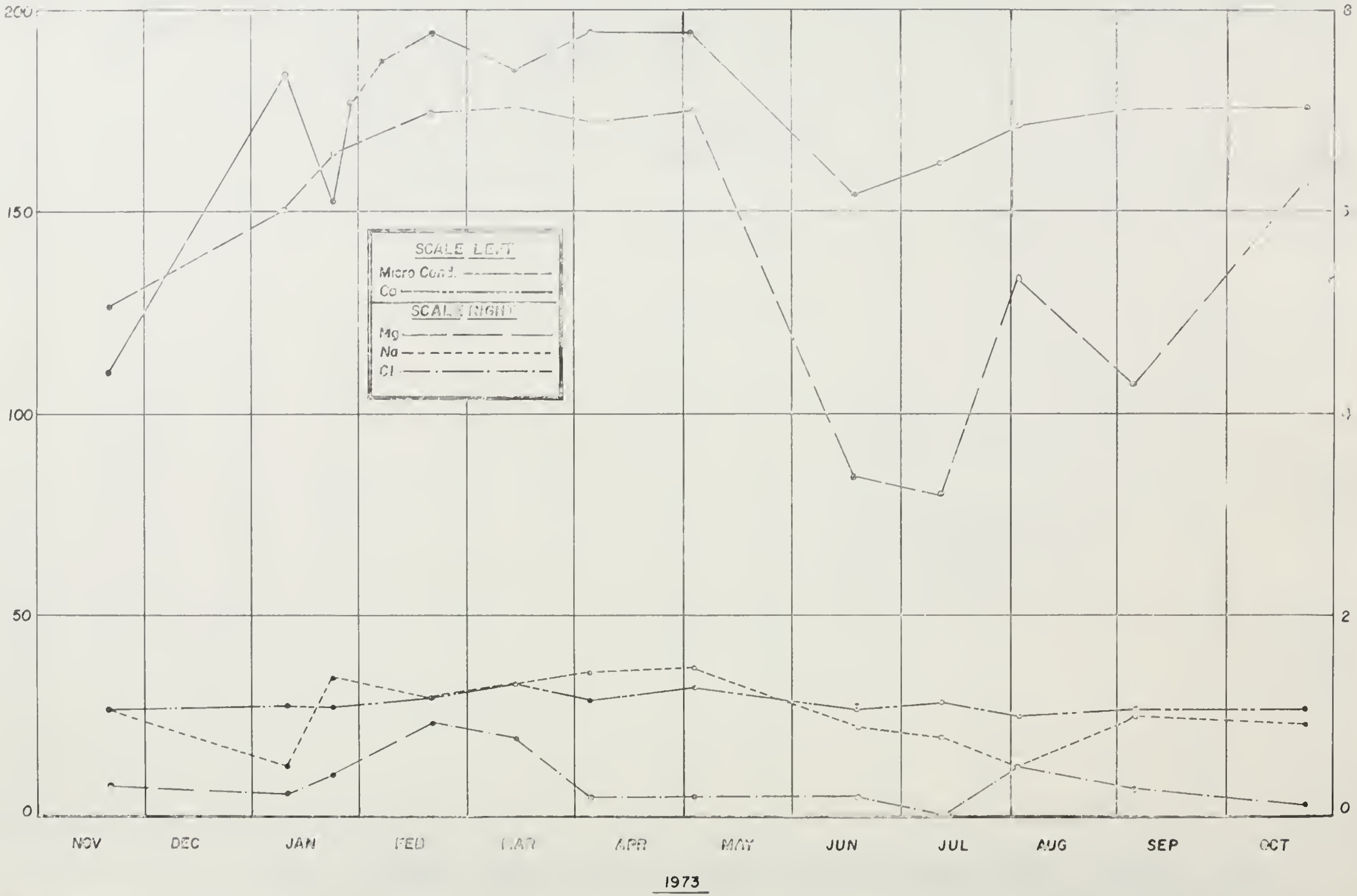

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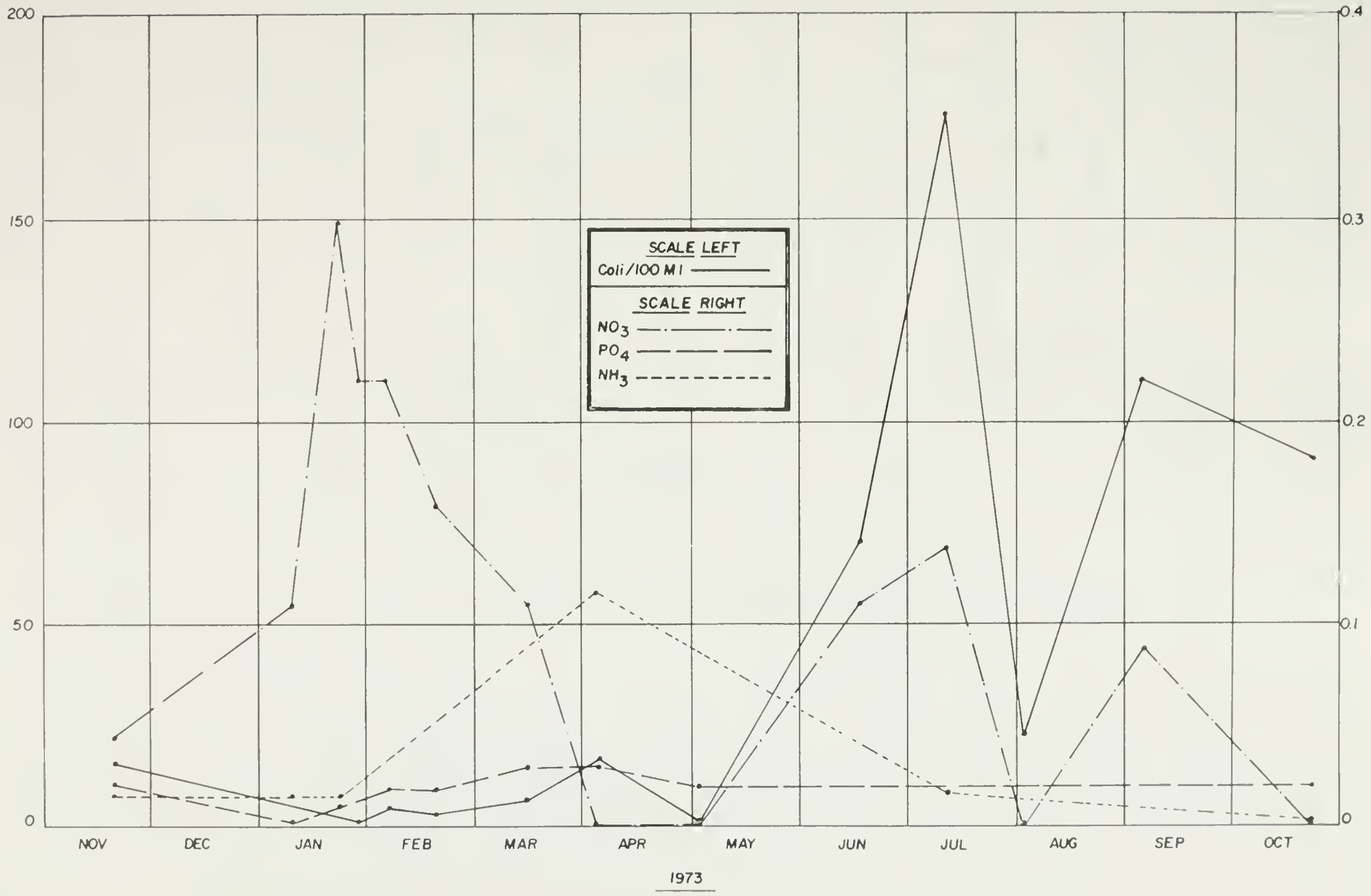

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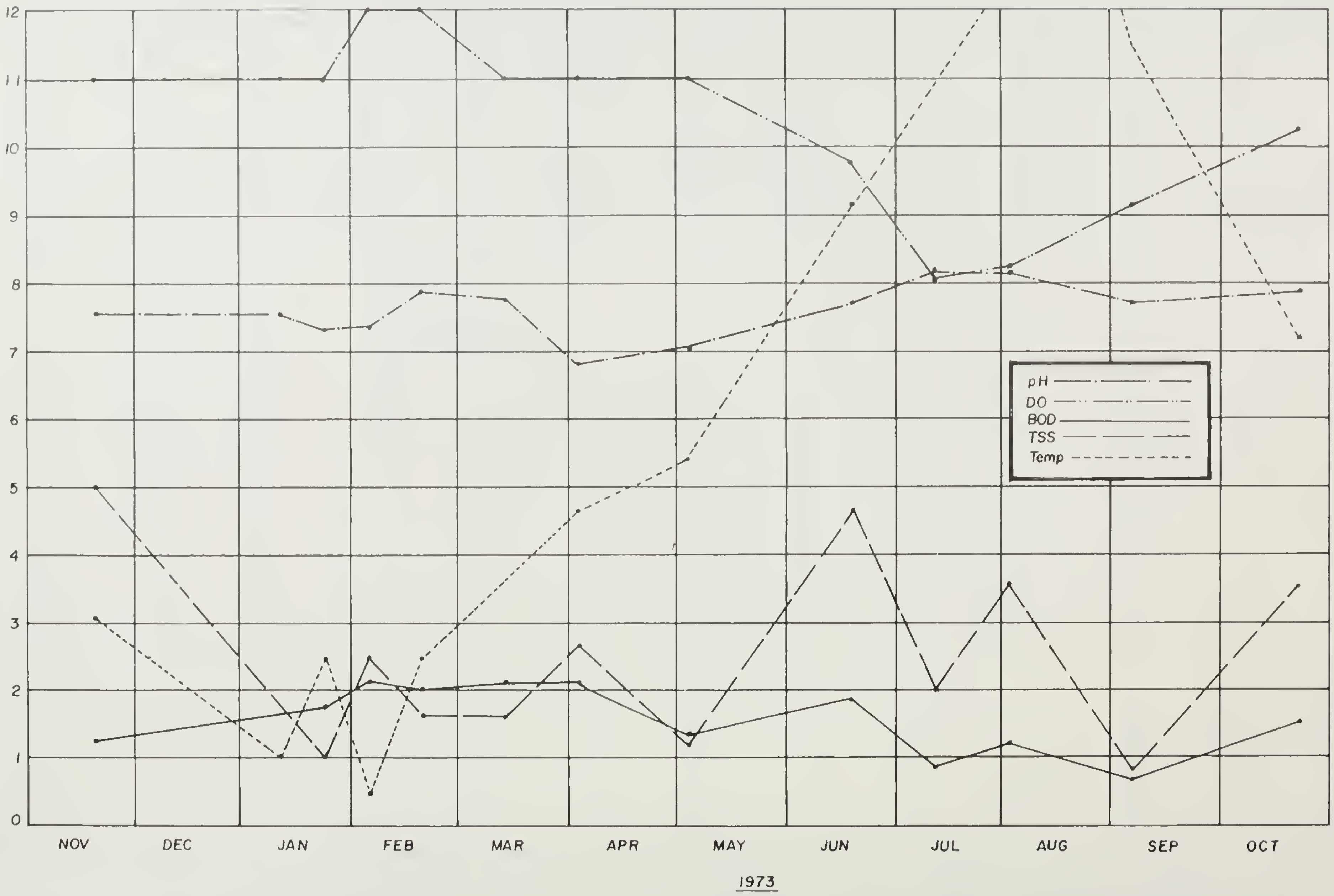

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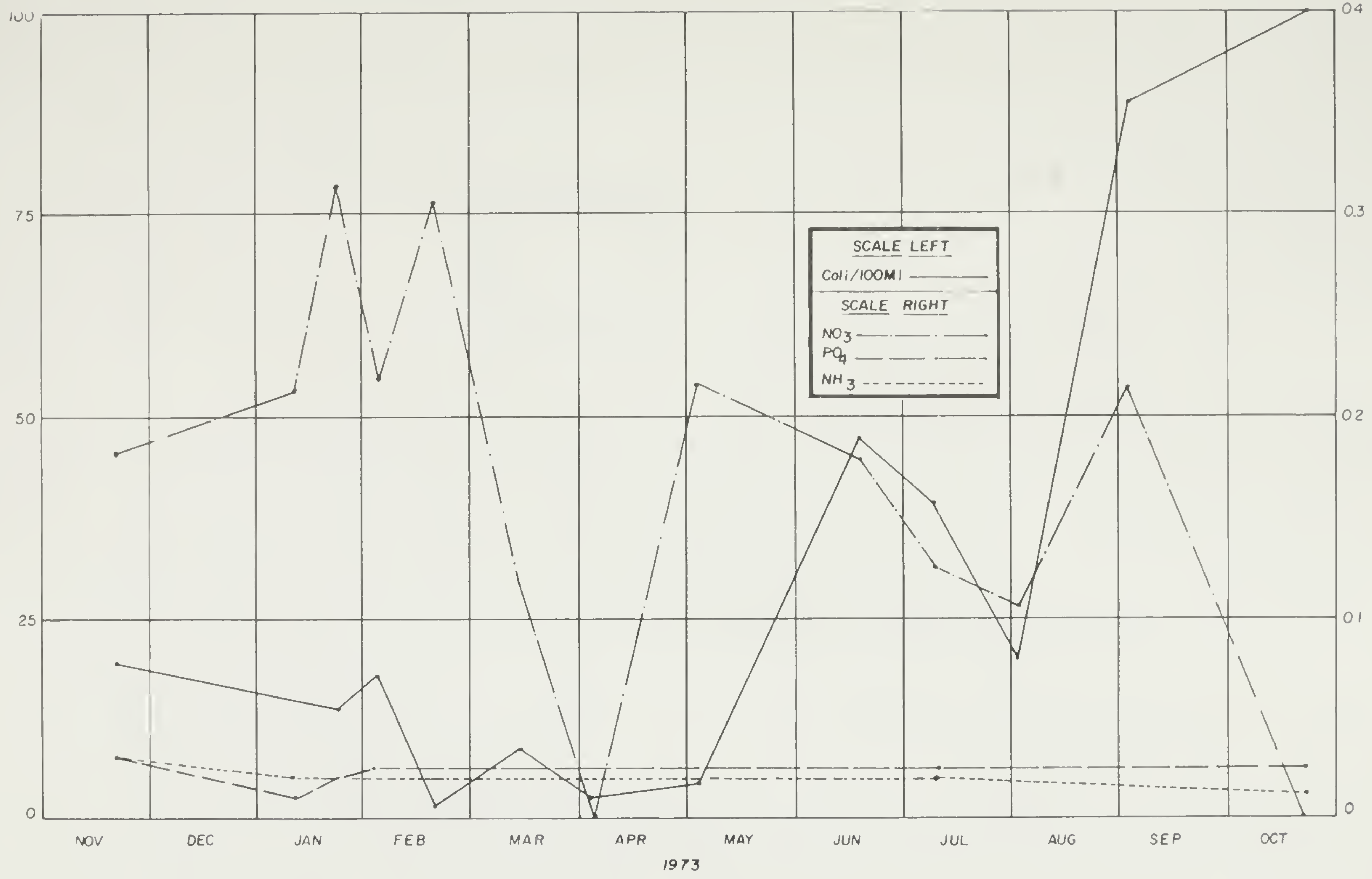

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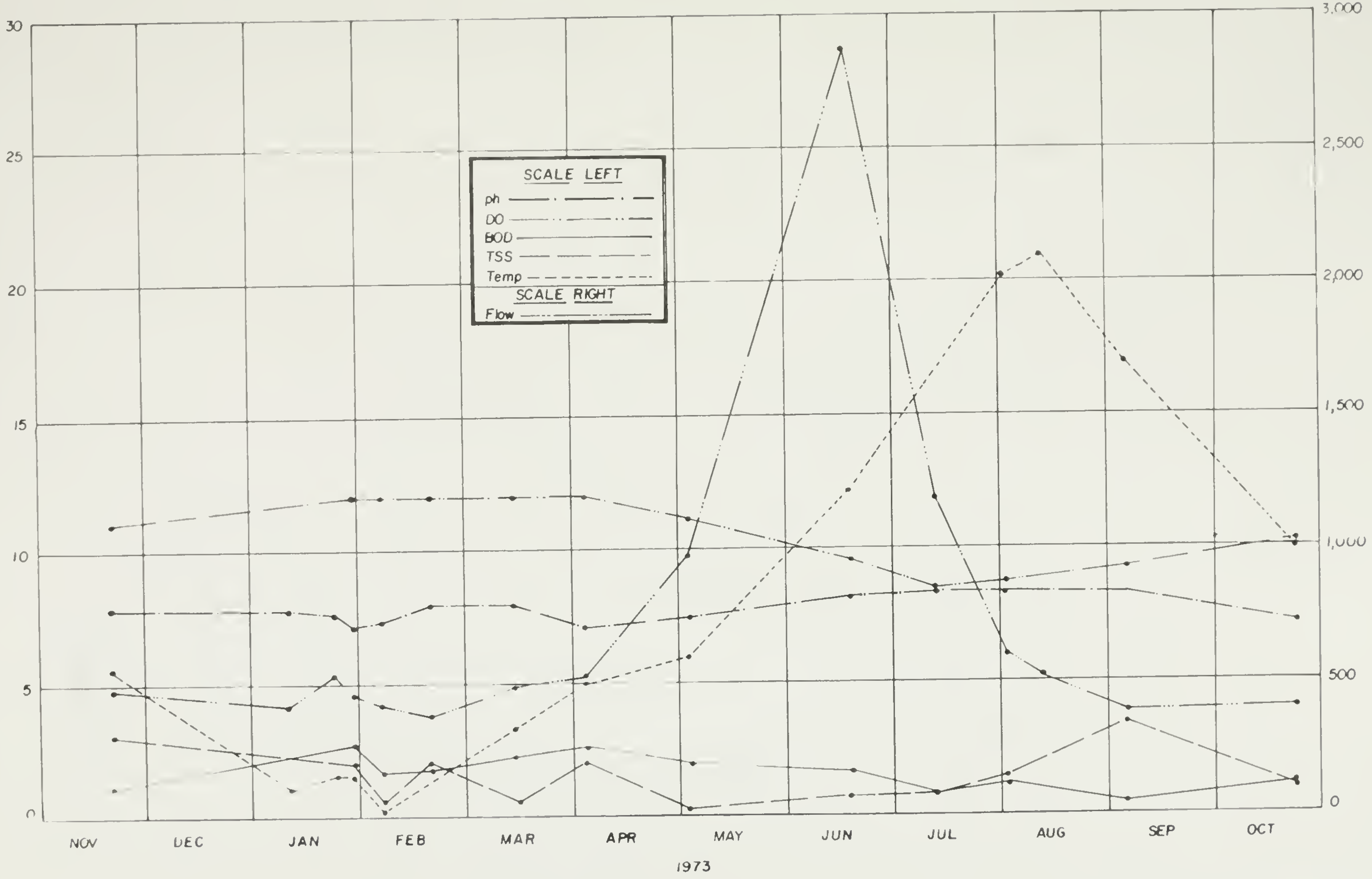


Appendix B

APPENDIX B

AVAILABLE CALCUALTED AVERAGE FLOW OF STREAMS MONITORED BY THE FD 208 AGENCY (1976-1977)

Stream or Segment (approximate station number 26)	Flow (cfs)
UPPER FLATHEAD DRAINAGE	
Ashley Creek (@ Kalispell)	34
Whitefish River	290
Stillwater River	396
Swan River	609
LOWER FLATHEAD DRAINAGE	
(2) Finley Creek	84
(4) Lower Jocko	183
(6) Lower Mission	166
(7) Hillside Reservoir	8.5
(8) Dublin Gulch	22
(11) Mid-Mission	31
(12) Upper Mission	86
(13) Mid-Post	24
(14) Upper Post	128
(16) Lower N. Crow	13
(17) Lower Spring Creek	28
(18) Mid-Crow	110
(19) Lower Crow	85
(21) Lower Mud	18
(24) Upper North Crow	24
(25) Upper Mud	4.5
(26) Lower Pablo "A" Canal	105
(28) Pablo "A" Canal	238

Appendix C

APPENDIX C

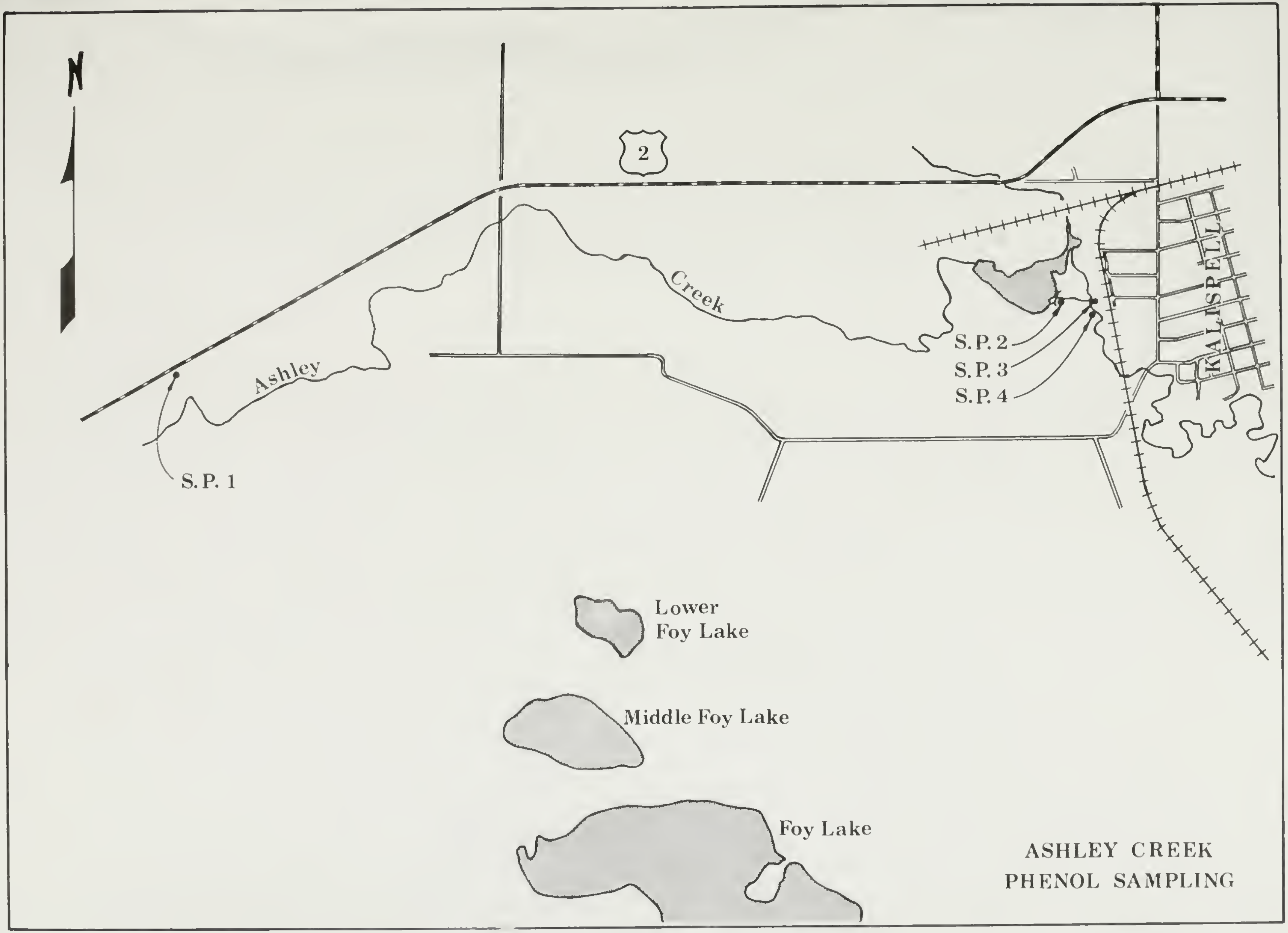
ASHLEY CREEK PHENOL SAMPLING

In order to further evaluate the extent of phenol pollution in Ashley Creek as it passes through Kalispell, four additional sampling stations were established (Figure A). These stations represent sampling locations that the FD 208 Agency Staff felt would help isolate the increase in phenol identified in the initial sampling. Samples were collected by the FD 208 Agency and phenol analysis was performed by the State of Montana (Dept. of Health and Environmental Sciences). The following results were obtained:

PHENOL ANALYSIS

Station Location		Concentration (ug/liter)
No. 1	West of Town	>1
No. 2	Ashley Creek Control Structure	5
No. 3	Spring Creek Tributary	3
No. 4	Collapsed Bridge	6

This data verifies the previous analysis that showed the phenol concentration increases near Kalispell above that normally indicated for a satisfactory freshwater environment (1-ug/l).



ASHLEY CREEK
PHENOL SAMPLING

Figure A